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National Dioxin Study Tier 4 - Combustion Sources: Final Test Report - Site 6 Wire Reclamation Incinerator WRI-A

Radian Corp., Research Triangle Park, NC

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16. ABSTRACT

This report summarizes the results of a dioxin/furan emissions test of a wire reclamation incinerator equipped with an afterburner for hydrocarbon emissions control. The wire reclamation incinerator is used for recovery of copper from coated copper wire and drained transformer cores. The test was the sixth in a series of several dioxin/furan emissions tests conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions.

Wire reclamation incinerators are one of 8 combustion source categories that have been tested in the Tier 4 program. The tested incinerator, hereafter referred to as incinerator WRI-A, was selected for this test after an initial information screening and a one-day pretest survey visit. Incinerator WRI-A is considered representative of the wire reclamation incinerator population in the United States.

Data presented in the report include dioxin (tetra through octa homologue + 2378 TCDD) and furan (tetra through octa homologue + 2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

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TIER 4 — COMBUSTION SOURCES

Final Test Report — Site 6
Wire Reclamation Incinerator WRI — A

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FOREWORD

This report is the result of a cooperative effort between the Office of Research and Development's Hazardous Waste Engineering Research Laboratory (HWERL) and the Office of Air Quality Planning and Standard's Monitoring and Data Analysis Division (MDAD). The overall management of Tier 4 of the National Dioxin Study was the responsibility of MDAD. In addition, MDAD provided technical guidance for the source test covered by this report. HWERL was directly responsible for the management and technical direction of the source test.

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1.0 INTRODUCTION

This report summarizes the results of a dioxin/furan[a] emissions test of a wire reclamation incinerator equipped with an afterburner for hydrocarbon emissions control. The wire reclamation incincerator is used for recovery of copper from coated copper wire and drained transformer cores. The test was the sixth in a series of several dioxin/furan emissions tests conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions.

Wire reclamation incincerators are one of 8 combustion source categories that have been tested in the Tier 4 program. The tested incinerator, hereafter referred to as incinerator WRI-A, was selected for this test after an initial information screening and a one-day pretest survey visit. Incinerator WRI-A is considered representative of the wire reclamation incinerator population in the United States. Wire processed in the incinerator is obtained from a local power supply company and contains only small quantities of polyvinyl chloride (PVC) coated wire. Transformer cores processed in the incinerator are obtained from another source and are certified to have contained oil with less than 500 ppm of polychlorinated biphenyls (PCB's).

This test report is organized as follows. A summary of test results and conclusions is provided in Section 2.0, followed by a detailed process description in Section 3.0. The source sampling and analysis plan is outlined in Section 4.0, and the field sampling and analytical data are presented in Section 5.0. Sections 6.0 through 9.0 present various testing details. These include descriptions of the sampling locations and procedures (Section 6.0), descriptions of the analytical procedures (Section 7.0), and a summary of the quality assurance/quality control results (Section 8.0). The appendices contain data generated during the field sampling and analytical activities.

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[a] The term "dioxin/furan" and the acronyms PCDD and PCDF as used in this report refer to the polychlorinated dibenzo-p-dioxin and dibenzofuran isomers with four or more chlorine atoms.

2.0 SUMMARY

2.1 SOURCE SAMPLING AND ANALYSIS OVERVIEW

The host plant is a scrap metal recovery facility that processes mainly aluminum and copper scrap. Wire reclamation incinerator WRI-A is used to recover copper from insulated wire and drained transformer cores. The incinerator is a batch feed unit similar to others in the wire reclamation industry.

A process flow diagram of the incincerator and associated afterburner is shown in Figure 2-1. Wire and/or transformer cores are charged to the primary chamber of the furnace on metal trays using a fork lift. Exhaust gases from the primary chamber flow into a settling chamber, where large particulate matter settles out, and then into a gas-fired afterburner prior to atmospheric discharge.

The gaseous and solid sampling performed during the test program is summarized in Table 2-1. Sampling for dioxin and furan was performed at the afterburner outlet exhaust stack in each of a series of six test runs conducted on March 19 through March 27, 1985.

Only insulated wire was charged to the furnace during three test runs, and a combination of insulated wire and drained transformer cores was charged to the furnace during the other three runs. The dioxin/furan sampling was based on the October 1984 draft of the Modified Method 5 (MM5) procedure developed by the American Society of Mechanical Engineers (ASME) for measuring emissions of chlorinated organic compounds. Modifications of the ASME procedure used at this test site are discussed in Section 6.1.2.1. MM5 train components and rinses were analyzed for dioxins and furans by EMSL-RTP and ECL-Bay St. Louis, two of three EPA laboratories collectively known as Troika. The dioxin/furan analysis quantified 2378-TCDD and the tetra- through octa-dioxin/furan homologues present in the samples.

Dioxin/furan precursor analyses were performed by Radian on samples of wire insulation and combustible components of the drained transformer cores. The specific dioxin precursors analyzed for were chlorophenols, chlorobenzenes, polychlorinated biphenyls, total organic halogen (TOX) and

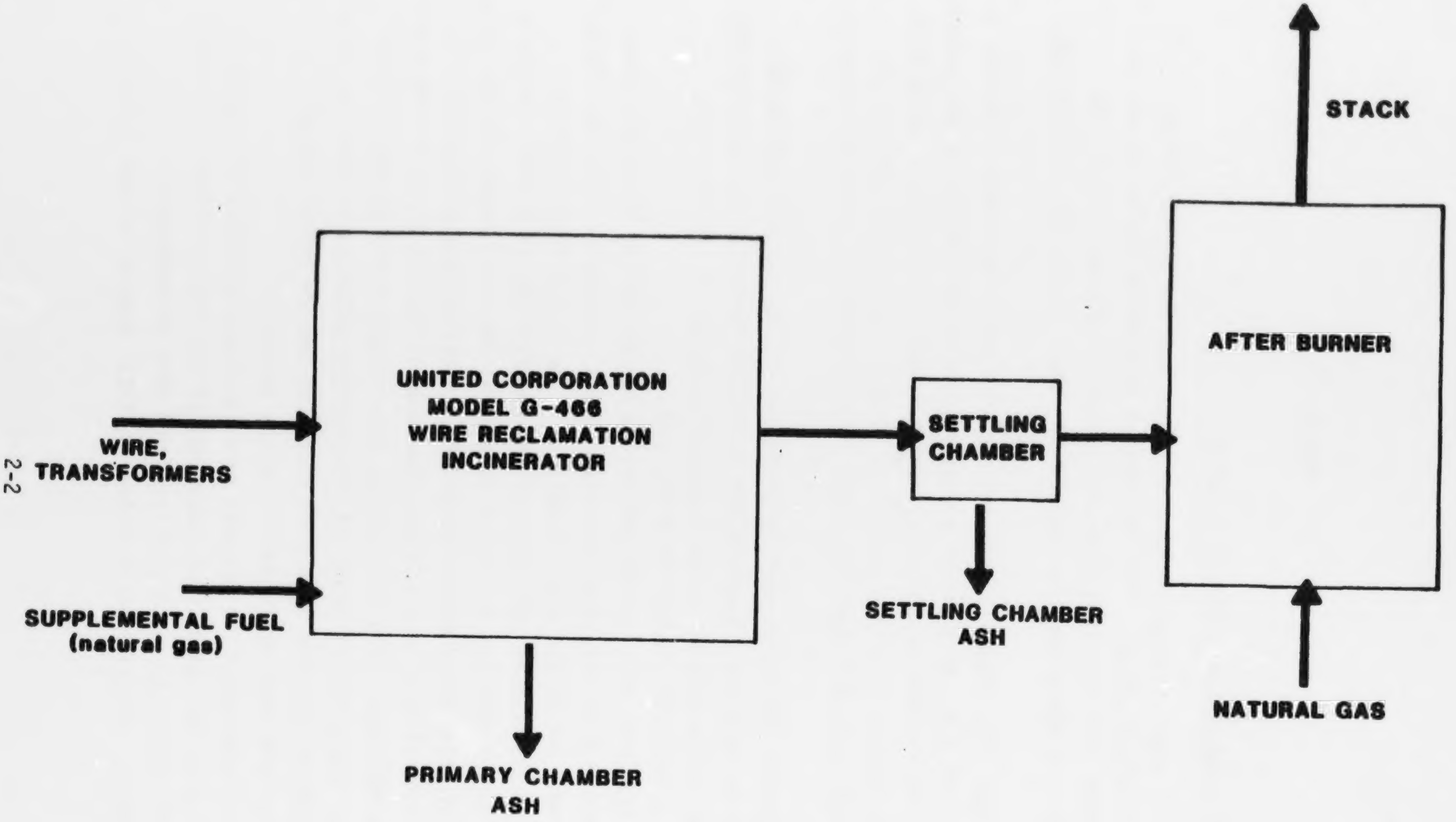

STACK
UNITED CORPORATION MODEL G-466 WIRE RECLAMATION INCINERATOR
WIRE, TRANSFORMERS
SUPPLEMENTAL FUEL (natural gas)
SETTLING CHAMBER
AFTER BURNER
PRIMARY CHAMBER ASH
SETTLING CHAMBER ASH
NATURAL GAS

FIGURE 2-1. PROCESS FLOW DIAGRAM OF WIRE RECLAMATION INCINERATOR WRI-A

TABLE 2-1. SOURCE SAMPLING AND ANALYSIS OVERVIEW FOR INCINERATOR WRI-A

Item	Item Description
1. Number of test runs	- Total of six test runs.
	- Three test runs with wire only in incinerator feed (Runs 01, 02, 06).
	- Three test runs with wire and transformers in incinerator feed (Runs 03, 04, 05).
2. Gaseous Sampling	- MM5 sampling at afterburner outlet exhaust stack. (Runs 01-06). Dioxin/furan analysis.
	- HCl Train sampling at afterburner outlet exhaust stack (Runs 01-06). HCl analysis.
	- EPA reference Methods 2 and 4 at afterburner outlet exhaust stack (Runs 01-06). Gas velocity and moisture.
	- Integrated bag sampling at afterburner outlet exhaust stack (Runs 01-06). CO_2, O_2, N_2 analysis for molecular weight determination.
	- Continuous monitoring of CO, CO_2, O_2, NO_x, total hydrocarbons at afterburner outlet exhaust stack (Runs 01-06).
3. Solids Sampling	- Wire insulation sampling (Runs 01-06). Dioxin/furan precursor analysis, total chlorine analysis.
	- Transformer combustibles sampling (Runs 03, 04, 05) Dioxin/furan precursor analysis, total chlorine analysis.
	- Settling chamber ash sampling (Runs 01-06). Dioxin/furan analysis.
	- Incinerator bottom ash sampling (Runs 01-06). Dioxin/furan analysis.
	- Soil sampling (one composite sample from 10 locations.) Potential dioxin/furan analysis.

total chlorine. Dioxin/furan analyses were performed by Troika on ash samples raked from the primary chamber and setting chamber after each test. A single composite soil sample was taken and transferred to Tier 7 of the National Dioxin Study for potential dioxin/furan analysis.

Continuous emissions monitoring (CEM) was performed at the afterburner outlet stack for CO, CO_2, NO_x, total hydrocarbons (THC), and O_2. The continuous monitoring data were used in conjunction with process data to document the stability of combustion conditions during the test. Hydrochloric acid (HCl) emissions sampling was also performed at the afterburner outlet exhaust stack during each test.

2.2 SUMMARY OF RESULTS

Test results for Site WRI-A are summarized in Figure 2-2. The data are organized according to the feed type (i.e., wire-only or wire and transformers). An atmospheric damper on the stack located immediately below the stack sampling ports was open during three of the runs and closed during the other three runs. Other process conditions were fairly consistent between test runs. Detectable quantities of all dioxin/furan species of interest were found in the stack gas samples. However, some analytical difficulties were encountered due to the large quantities of organic compounds present in the MM5 train samples. As a result, complete data for all homologues were not reported for all test runs. In spite of the low surrogate recoveries for the tetra-, hepta-, and octa-chlorinated homologues, reported values should be regarded as minimum levels and actual values could have been considerably higher. These analytical difficulties are further discussed in Section 8.3.1.1.

As shown in Figure 2-2, average as-measured stack gas concentrations of 2378-TCDD, total PCDD, and total PCDF were 0.09 ng/dscm, 124 ng/dscm, and 225 ng/dscm for the wire feed runs and 0.08 ng/dscm, 605 ng/dscm, and 715 ng/dscm for the wire and transformer feed runs. This corresponds to hourly mass emission rates of 0.03 ug/hr, 114 ug/hr and 205 ug/hr for the wire feed runs and 0.06 ug/hr, 522 ug/hr, and 626 ug/hr for the transformer and wire feed runs. The hepta- and octa- homologues were the predominant dioxin/furan species present in the stack gas emissions.

INCINERATOR DATA Ⓑ

Feed Description	Feed Rate (kg/hr)	Incinerator Temperature (°C)
Wire only	362	566
Wire and Transformers	313	558

CONTINUOUS EMISSIONS MONITORING DATA Ⓐ

O_2	6.6% vol
CO_2	13.5% vol (@ 3% O_2)
CO	5131 ppmv (@ 3% O_2)
THC	577 ppmv (@ 3% O_2)
NO_x	111 ppmv (@ 3% O_2)

FEED DATA Ⓑ

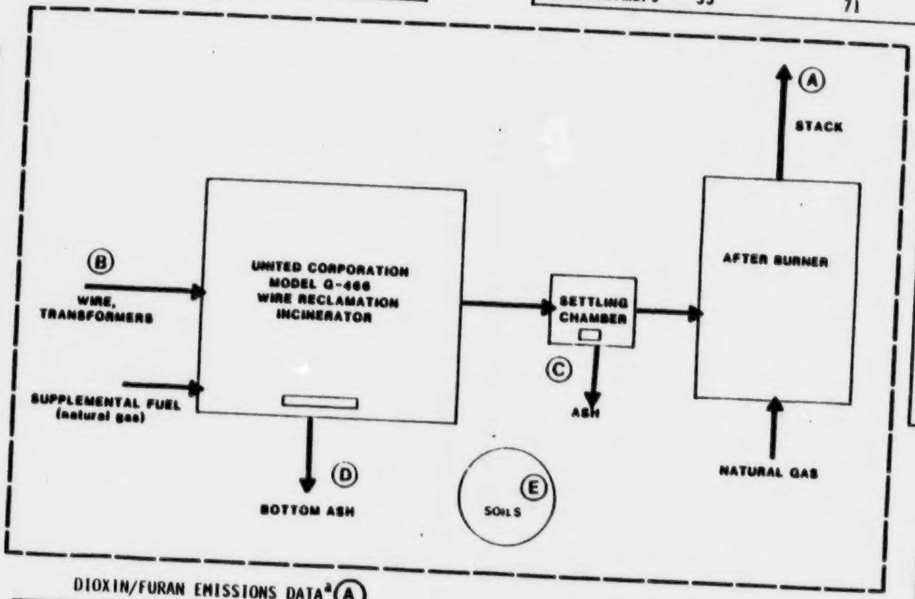
	Percent Combustibles	% Combustibles from Transformers
Wire Only	13	--
Wire and Transformers	35	71

FLUE GAS PARAMETER DATA Ⓐ

Flow Rate: 15.4 dscmm
Temperature: 677°C
Moisture: 13.8 %

FEED PRECURSOR DATA Ⓑ

Wire Feed Only	
PCB's	Not detected
Chlorobenzenes	Not detected
Chloropehnols	Trace
Wire and Transformer Feed	
PCB's	Not detected
Chlorobenzenes	Not detected
Chlorophenols	0.2 ug/g
Total Chloride	269 ug/g


Ⓑ
WIRE, TRANSFORMERS
SUPPLEMENTAL FUEL (natural gas)
UNITED CORPORATION MODEL G-466 WIRE RECLAMATION INCINERATOR
Ⓓ
BOTTOM ASH
SETTLING CHAMBER
Ⓒ
ASH
Ⓔ
SOILS
AFTER BURNER
NATURAL GAS
Ⓐ
STACK

INCINERATOR ASH DATA Ⓒ Ⓓ

Species	Concentration (ppb) Primary Chamber	Concentration (ppb) Settling Chamber
Wire Feed		
2378 TCDD	0.20	0.1
Total PCDD	243	529
Total PCDF	746	2643
Wire and Transformer Feed		
2378 TCDD	0.01	0.03
Total PCDD	19	236
Total PCDF	80	684

DIOXIN/FURAN EMISSIONS DATA[a] Ⓐ

	Wire Feed			Wire and Transformer Feed		
Species	Concentration (ng/dscm)	Emission Rate (ug/hr)	Emission Factor (ng/kg)	Concentration (ng/dscm)	Emission Rate (ug/hr)	Emission Factor (ug/kg)
2378 TCDD	0.09	0.03	0.3	0.08	0.06	0.19
Total PCDD	124	114	356	605	522	1440
Total PCDF	225	205	633	715	626	1840

[a] Not all analytical results for the stack samples met the quality assurance objectives. Therefore, reported values should be regarded as lower bound estimates. The actual values could have been considerably higher.

CHLORIDE EMISSIONS DATA Ⓐ

Emissions Type	Concentration (ng/dscm)	Emission Rate (mg/yr)
Wire Feed		
Train Total	1116	1.08
Back Half	741	.70
Front Half	375	.38
Wire and Transformer Feed		
Train Total	438	.39
Back Half	301	.27
Front Half	131	.12

Figure 2-2. Data Summary for Incinerator WRI-A.

Ash samples from the primary incinerator chamber and the setttling chamber were also analyzed for dioxin/furan content. The average primary chamber ash concentrations of 2378-TCDD, total PCDD, and total PCDF were 0.2 ppb, 243 ppb, and 746 ppb for the wire feed runs and 0.01 ppb, 19 ppb, and 80 ppb for the wire and transformer feed runs. The settling chamber ash samples contained higher concentrations of dioxin/furan than the primary chamber samples. The average concentrations of 2378-TCDD, total PCDD, and total PCDF for the settling chamber ash samples were 0.1 ppb, 529 ppb, and 2643 ppb for the wire feed runs, and 0.06 ppb, 236 ppb, and 684 ppb for the wire and transformer feed runs, respectively.

The incinerator feed rate during the testing averaged 362 kg/hr (799 lb/hr) for the wire feed runs and 313 kg/hr (691 lb/hr) for the wire and transformer runs. The primary chamber temperature was typically on the order of 560°C (1045°F), and the maximum afterburner temperature ranged from about 985°C (1805°F) to 1090°C (2000°F). Total chloride emissions from the incinerator averaged 1116 mg/dscm (1.08 kg/hr) for the wire feed runs and 438 mg/dscm (0.39 kg/hr) for the wire and transformer feed runs. Average as-measured continuous flue gas monitoring results for the afterburner outlet stack were: O_2, 6.6% vol; CO_2, 13.5% vol; CO, 5131 ppmv; THC, 577 ppmv, and NO_x, 111 ppmv.

3.0 PROCESS DESCRIPTION

This section describes the host site and the wire reclamation incinerator tested. Data summarizing the operation of the incinerator and afterburner during the test periods are presented in Section 5.0.

3.1 HOST SITE DESCRIPTION

The host site is a scrap metal processing facility that handles mainly aluminum and copper-bearing scrap materials. A plot plan of the plant is shown in Figure 3-1. The facility operates a single wire reclamation incinerator that recovers copper from insulated copper wire and copper-bearing drained transformer cores. The incinerator is referred to as wire reclamation incinerator WRI-A in this test report and in the Tier 4 program. Two metal crushing devices are used to bundle aluminum scrap prior to resale. Hand sorting of small metal pieces from metal punching facilities is also practiced at the host site.

3.2 WIRE RECLAMATION INCINERATOR DESCRIPTION

Wire reclamation incinerator WRI-A is a United Corporation Model G-466 incinerator with a rated capacity of 1200 lb/hr of insulated wire. The unit was installed in 1978 and typically operates 8 hours per day, 5 days per week between the hours of 0900 and 1700. As shown in Figures 3-2 and 3-3, the incinerator consists of a primary combustion chamber, a settling chamber, and an afterburner. Natural gas is fired in the primary combustion chamber and in the afterburner to supplement the heating value of the combustible materials in the copper-bearing scrap.

Insulated copper wire and/or copper-bearing drained transformer cores are fed to the primary chamber of the incinerator on a steel pallet using a fork lift. The incinerator is operated in a batch mode, with the combustion cycle for each batch of scrap feed lasting between 1 and 2 1/2 hours. The number of feed cycles per day varies from 4 to 6 depending on the type and quantity of materials charged.

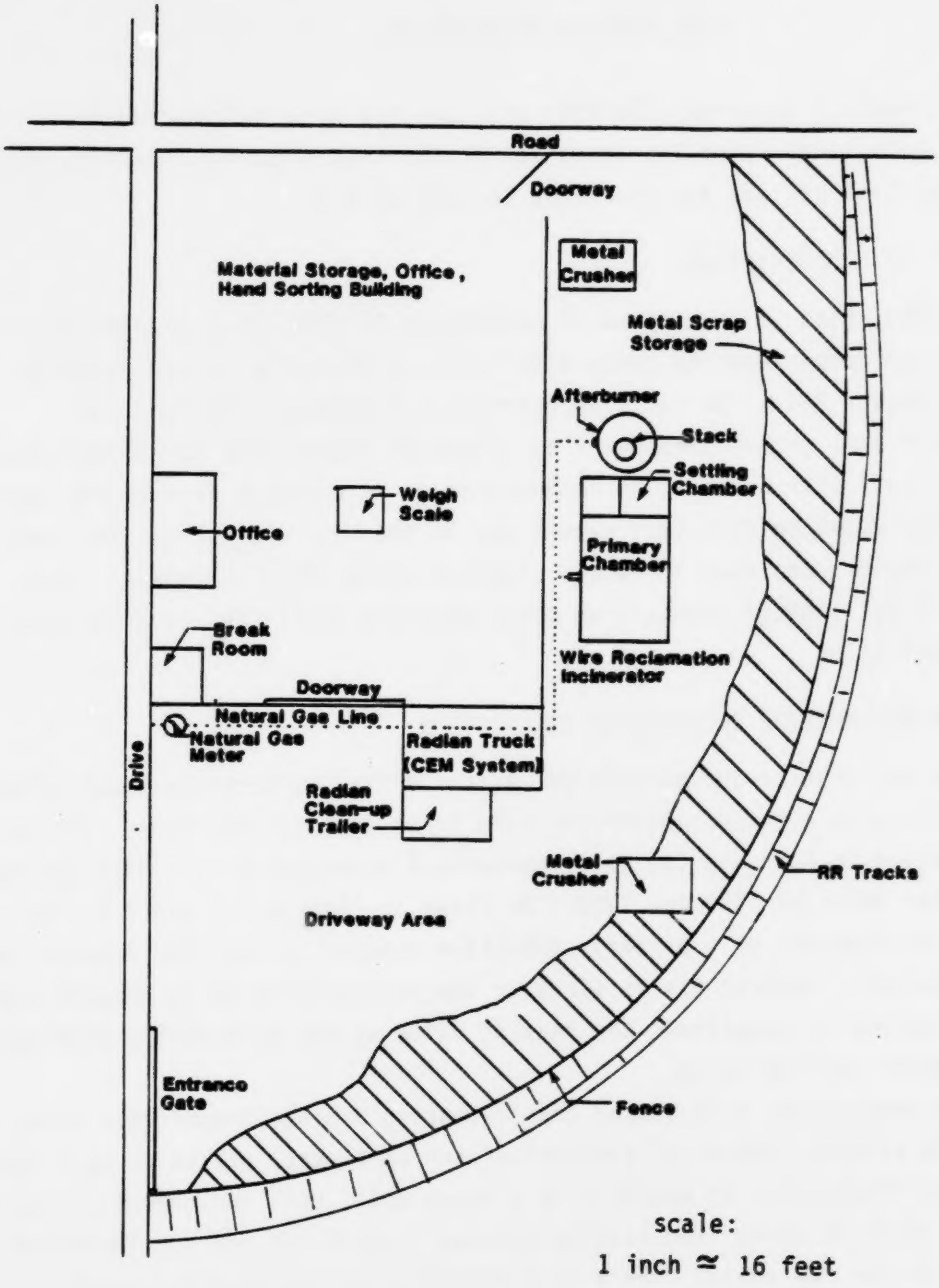

Road
Doorway
Metal Crusher
Material Storage, Office, Hand Sorting Building
Metal Scrap Storage
Afterburner
Stack
Settling Chamber
Weigh Scale
Office
Primary Chamber
Break Room
Wire Reclamation Incinerator
Doorway
Natural Gas Line
Natural Gas Meter
Radian Truck [CEM System]
Drive
Radian Clean-up Trailer
Metal Crusher
RR Tracks
Driveway Area
Entrance Gate
Fence
scale:
1 inch ≃ 16 feet

FIGURE 3-1. PLOT PLAN FOR SITE 06

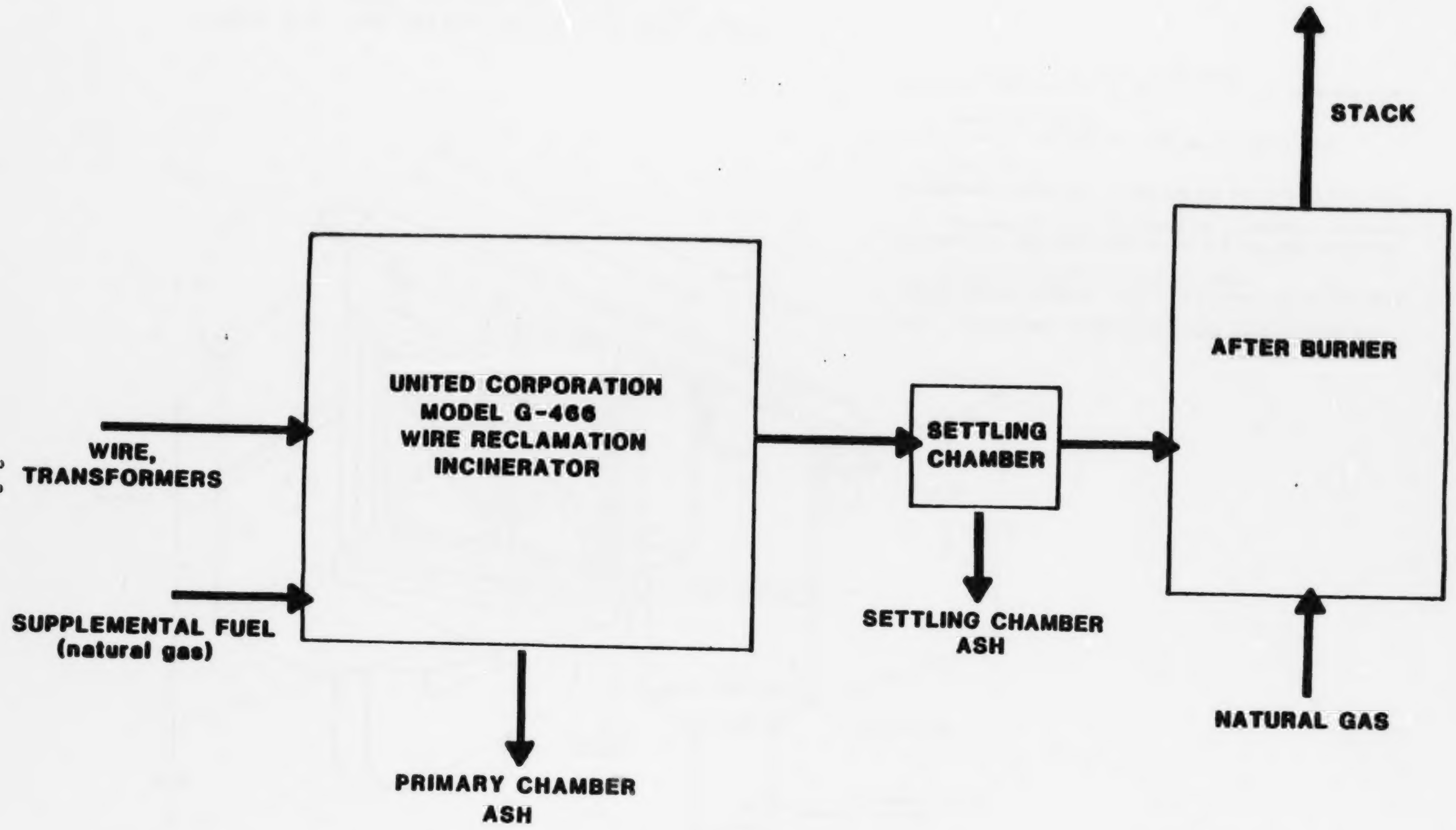
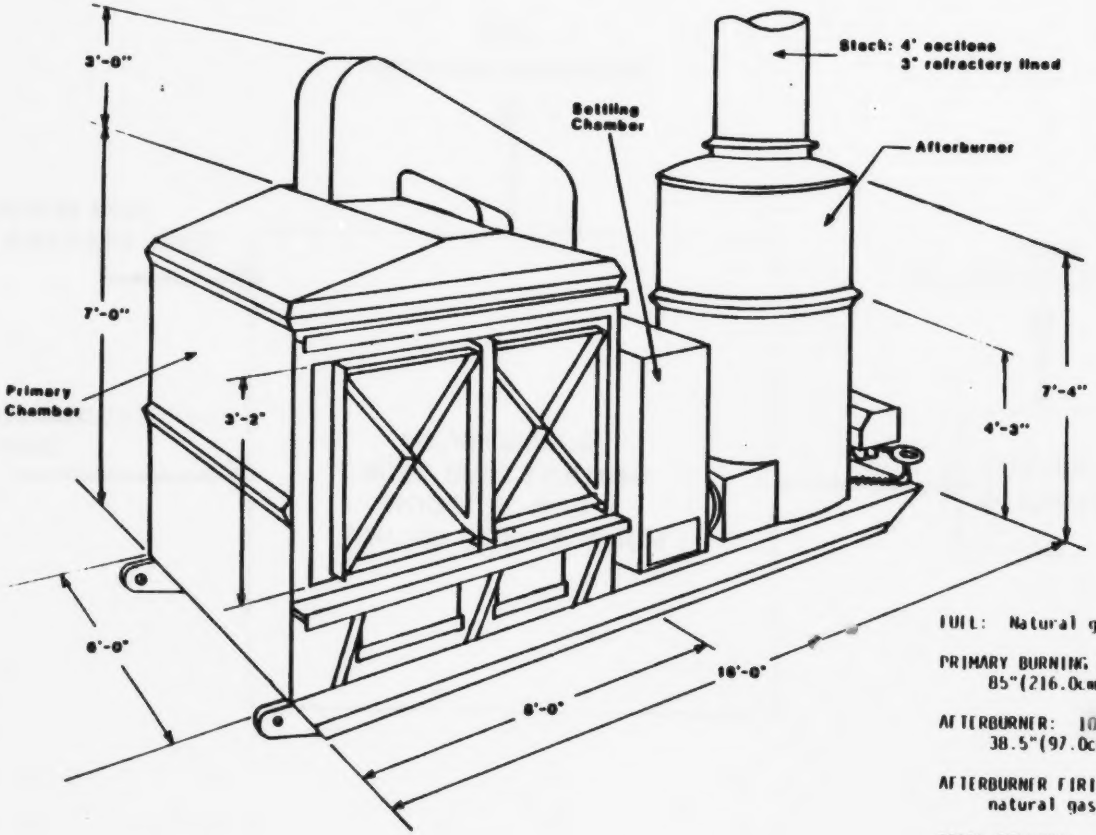

STACK
AFTER BURNER
UNITED CORPORATION MODEL G-466 WIRE RECLAMATION INCINERATOR
WIRE, TRANSFORMERS
SUPPLEMENTAL FUEL (natural gas)
SETTLING CHAMBER
SETTLING CHAMBER ASH
PRIMARY CHAMBER ASH
NATURAL GAS

FIGURE 3-2. PROCESS FLOW DIAGRAM OF WIRE RECLAMATION INCINERATOR WRI-A



3'-0"
7'-0"
Primary Chamber
3'-2"
6'-0"
8'-0"
10'-0"
Settling Chamber
Stack: 4' sections
3" refractory lined
Afterburner
4'-3"
7'-4"

FUEL: Natural gas, approximately 1200 cubic feet per hour.

PRIMARY BURNING CHAMBER: Refractory lined. 38"(96.5cm.)high. 85"(216.0cm.)wide. 63"(160.0cm.)deep.

AFTERBURNER: 106.5"(270.5cm.)high, O.D. 48"(122.0cm.),I.D. 38.5"(97.0cm.). Stack lined with 3" castable refractory.

AFTERBURNER FIRING UNIT: 1,400,000 BTU per hour, fired with natural gas.

STEEL PALLETS: 72"(183.0cm.) by 50"(127.0cm.). High temperature pallets.

CAPACITY: Feed charges of 1000-1200 lbs. of insulated wire, transformers, and other scrap metal.

FIGURE 3-3. THE UNITED CORPORATION Model G-466 WIRE RECLAMATION INCINERATOR

The feed to the incinerator varies with each charge. Plant personnel estimate that 70 to 80 percent of the charges consist solely of different types of wire. Each wire feed batch is weighed before and after processing in the incinerator. The copper recovery efficiency (i.e., mass of copper recovered per mass of incinerator feed) for wire-only batches is typically 85 to 90 percent, with the remaining 10 to 15 percent being attributable to burned off wire insulation and coating. Most of the wire is supplied by a local power company and consists predominantly of weatherproof wire with tar-based insulation. Some of the wire (i.e., "peddler wire") is purchased from individual scrap wire collectors who transport the wire to the plant via pick-up truck. The coating on much of this peddler wire has been partially burned off prior to receipt by the plant.

Polyvinyl chloride (PVC) coated wire represents only a small percentage of the wire processed in incinerator WRI-A. Most of the PVC wire obtained by the plant is baled up and sold for processing elsewhere. The incinerator is permitted to process up to 68 pounds of PVC plastic per hour, which corresponds to approximately 200 pounds of PVC-insulated wire per hour. However, the percentage of PVC coated wire in a typical feed charge is estimated by plant personnel to be approximately 1 to 3 percent of the total charge weight. This corresponds to less than about 20 pounds per hour of PVC coated wire under typical feed rate conditions. PVC wire is not a desirable feed componenet because of corrosion problems created by HCl emissions.

Drained transformer cores are co-fired with small amounts of wire in approximately 20 to 30 percent of the charges . The transformer cores consist of an alternating series of copper annular rings and cardboard annular rings held together by a cylindrical cardboard/wood inner shell. The cardboard and wood parts are saturated with the oil that was contained in the transformer prior to being drained. Most of the transformer cores come from a single supplier, and all of them are certified to have contained oil with less than 500 ppm PCB. The transformer cores are partially disassembled and drained off-site by the supplier. The copper recovery efficiency of transformer cores processed in the incinerator varies from about 65 to 90 percent, with the remaining 10 to 35 percent being attributable to transformer combustibles.

Small transformers typically have much higher copper recovery efficiencies than large transformers.

At the beginning of each feed charge cycle, combustible materials in the feed are ignited using a single natural gas-fired burner that fires over the top of the feed pile. The primary chamber burner is turned off after 2 to 3 minutes when a self-sustaining flame is visually observed in the primary chamber through an inspection port in the charge door. The charge remains in the incinerator until the flame in the primary chamber dies out and smoke is no longer visible through an inspection port prior to the afterburner. When the combustion cycle is complete the copper remaining on the feed tray is removed using a fork lift and is allowed to cool in the plant yard.

The length of each combustion cycle depends on the type and quantity of copper-bearing materials on the feed tray, and on the number of previous charges made during the day. The length of the combustion charge cycles becomes shorter with each subsequent cycle in the day because of increasing primary chamber temperature. The first combustion cycle in a day requires approximately two and a half hours, while subsequent cycles typically last between one and two hours. In general, feed charges containing transformer cores require a longer combustion cycle then those that contain wire only.

Combustion conditions in the incinerator are controlled by varying the amount of air in the primary chamber. This can be achieved by adjusting the primary chamber doors and/or the settling chamber door. Plant personnel adjust the combustion conditions at infrequent intervals based on the flame conditions in the primary chamber and on the visual opacity from the afterburner outlet stack.

Temperatures in the primary chamber are not routinely monitored by the plant. Thermocouples installed for this test program showed that the mean temperature in the primary chamber is approximately 570^{o}C (1050^{o}F), with a range of approximately 315 to 650^{o}C (600 to 1200^{o}F). The lower temperatures typically occur at the beginning of the charge cycle before the new batch has been ignited.

3.3. AFTERBURNER DESCRIPTION

Exhaust gases from the primary chamber are drawn by natural draft through a breeching that connects the primary chamber to the settling chamber. Gases flow through the settling chamber to the afterburner, where combustion of unburned hydrocarbons is completed. The afterburner is fired with natural gas, and achieves temepratures ranging from about 980°C to 1090°C (1800-2000°F). The design energy input to the afterburner is 1.4 MMBtu/hr; natural gas consumption data obtained during the test were consistent with this.

Gases leaving the afterburner flow through a stack lined with 3 inches of castable refractory. The refractory-lined stack extends 12 feet above the top of the afterburner, and there is an additional 6 feet of unlined stack on top of this. An "atmospheric damper" is located in the refractory lined section, approximately 10 feet above the top of the afterburner. The atmospheric damper consists of an open-ended piece of ductwork perpendicular to the stack that serves as a source of fresh air dilution for the afterburner offgas. The damper was originally welded closed for the test program because it was believed to have an insignificant role in the afterburner operation. The closing of the damper eliminated the potential for ambient air/afterburner exhaust stratification at the dioxin/furan sampling location. However, it became apparent during the test program that the ambient air dilution at the atmospheric damper served as a source of combustion air for residual hydrocarbons leaving the afterburner. As a result, the atmospheric damper was re-opened after the first three test runs. These modifications will be discussed in more detail in Section 5.0.

4.0 TEST DESCRIPTION

This section describes the field sampling, process monitoring, and analytical activities that were performed for test Site WRI-A. The purpose of this section is to provide sufficient descriptive information about the test so that the test data presented in Section 5.0 can be easily understood. Specific testing details (specific sampling locations and procedures) are described in Section 6.0.

This section is divided into three parts. Section 4.1 summarizes field sampling activities, Section 4.2 summarizes process monitoring activities, and Section 4.3 summarizes analytical activities performed during the test program.

4.1 FIELD SAMPLING

Table 4-1 shows the source sampling and analysis matrix for test Site WRI-A. Six dioxin/furan emissions tests (Runs 01-06) were performed at the afterburner outlet exhaust stack. This sampling location is shown as point A in Figure 4-1. The type of feed materials and the open/closed status of the atmospheric damper are shown in Table 4-2 for each run. Dioxin/furan sampling followed the Modified Method 5 (MM5) sampling protocol developed by the American Society of Mechanical Engineers (ASME) for measuring emissions of chlorinated organic compounds. During each test run, at least 240 minutes of on-line sampling were performed with the MM5 trains.

Concentrations of HCl in the flue gas were determined for each test day at the afterburner outlet exhaust stack using another modification of EPA Method 5 (MM5/HCl). Continuous emission monitoring (CEM) of O_2, CO, CO_2, NO_x, and total hydrocarbons (THC) was performed during each of the test runs except for Run 06. Due to equipment malfunctions, THC was the only continuously monitored exhaust gas parameter during Run 06.

Three types of process samples were taken during the MM5 test periods: incinerator feed samples, primary chamber bottom ash samples, and settling chamber ash samples. Samples of combustible materials from each tray of wire and/or transformer feed were taken, and daily composite samples were prepared.

TABLE 4-1. SOURCE SAMPLING AND ANALYSIS MATRIX FOR SITE 06

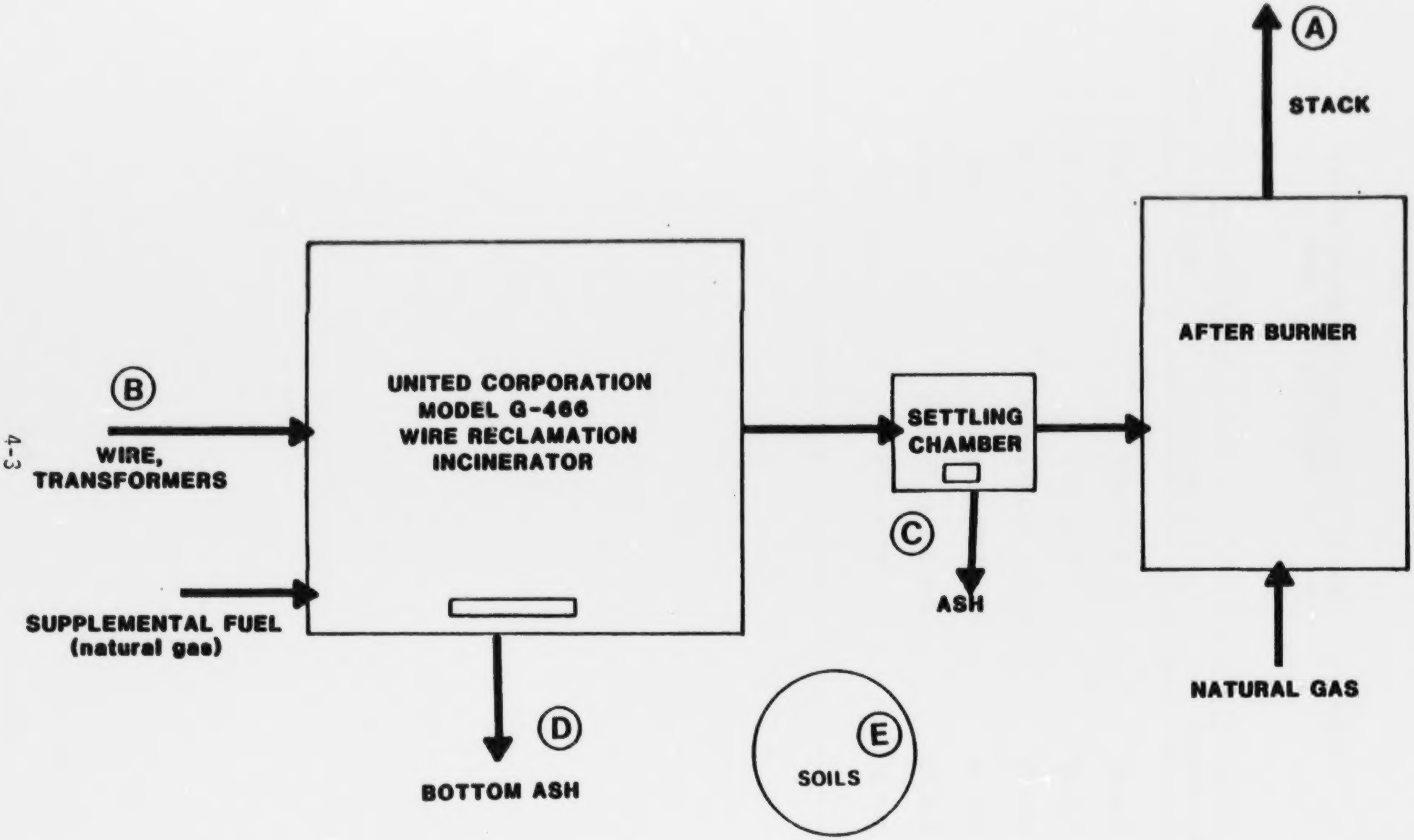
Sample Location	Sample Type or Parameter	Sampling Method	Analytical Method	Number of Samples or Frequency
1. Afterburner Outlet Exhaust Stack (Point A, Figure 4-1)	Dioxin, furan	Modified EPA Method 5	Gas chromatograph/ Mass spectrometer	Six test runs;[a,b] One per test day (Runs 01-06)
	Volumetric flow	EPA Method 2	Not applicable	Once per MM5 test run
	Molecular Weight	EPA Method 3	Gas chromatograph w/ thermal conductivity detector	Two integrated bag samples per MM5 test run
	Moisture	EPA Method 4	Gravimetric balance	Once per MM5 test run
	HCl	Modified EPA Method 5 (MM5/HCl)	Ion chromatogrpahy	Once per MM5 test run[c]
	CO, CO_2	In-stack filter probe and heat-traced Teflon sample line	Non-dispersive infrared analyzer	Continuously during MM5 test runs[d]
	O_2	Same as CO/CO_2	Paramagnetic analyzer	Continuously during MM5 test runs[d]
	NO_x	Same as CO/CO_2	Chemiluminescent analyzer	Continuously during MM5 test runs[d]
	SO_2	Same as CO/CO_2	Pulsed fluorescence analyzer	Continuously during MM5 test runs[d]
	Total Hydrocarbons (THC)	Same as CO/CO_2	Flame ionization detector	Continuously during MM5 test runs
2. Incinerator Feed Trays	Wire and transformer core combustible components for dioxin/ furan and dioxin/furan precursor analyses	Grab samples	Gas chromatography/ mass spectrometer	One composite sample per MM5 test run
3. Primary Chamber Bottom Ash	Bottom ash samples for dioxin/furan and dioxin/ furan precursor analyses	Grab samples taken after each test run	Gas chromatography/ Mass spectrometer	One composite sample per MM5 test run
4. Settling Chamber Ash	Settling chamber ash samples for dioxin/ furan and dioxin/furan precursor analyses	Grab samples taken after each test run	Gas chromatography mass spectrometer	One composite sample per MM5 test run
5. Plant Soils	Core samples for dioxin/ furan and dioxin/furan precursor analyses	Grab samples taken using bulb planter	Gas chromatography/ mass spectromuter	One composite sample from ten soil cores taken around plant property

[a] Runs 01, 02, and 06 were performed during wire-only feed conditions.

[b] Runs 03, 04, and 05 were performed during wire and transformer core feed conditions

[c] Two HCl train samples were taken during Run 01. See section 7 for discussion.

[d] CO/CO_2, O_2, NO_x, SO_2, data taken continuously for Runs 01-05 only. No continuous data for Run 06 due to equipment problems.



Ⓐ
STACK
AFTER BURNER
NATURAL GAS
Ⓑ
WIRE,
TRANSFORMERS
SUPPLEMENTAL FUEL
(natural gas)
UNITED CORPORATION
MODEL G-466
WIRE RECLAMATION
INCINERATOR
SETTLING
CHAMBER
Ⓒ
ASH
Ⓓ
BOTTOM ASH
Ⓔ
SOILS

FIGURE 4-1. SAMPLE POINT DIAGRAM FOR INCINERATOR WRI-A

TABLE 4-2. SUMMARY OF FEED AND ATMOSPHERIC DAMPER CONDITIONS DURING THE TEST RUNS

Run Number	Feed Description	Atmospheric Damper
Run 01	Wire only	closed
Run 02	Wire only	closed
Run 03	Wire & Transformers	closed
Run 04	Wire & Transformers	open
Run 05	Wire & Transformers	open
Run 06	Wire only	open

Primary chamber bottom ash and settling chamber ash samples were taken from the incinerator after each test run.

Soil samples were collected from ten locations at the plant site. The ten samples were combined into a single composite, which was held for potential dioxin/furan analysis pending evaluation of the MM5 dioxin/furan emissions data.

4.2 PROCESS DATA COLLECTION

Process data were collected to characterize the operation of the wire reclamation incinerator and the afterburner during the MM5 test periods. A complete record of the incinerator charge weights and times was maintained, along with natural gas consumption data. Thermocouples were installed in the primary chamber, the settling chamber, and two locations in the afterburner for measuring process temperatures. These data will be used in Section 5.1 with the CEM data to evaluate and compare combustion conditions during the MM5 test periods.

4.3 LABORATORY ANALYSES

Laboratory analyses performed on samples from test Site WRI-A included dioxin/furan analyses, dioxin/furan precursor analyses, and total chloride analyses. These analyses are discussed in Sections 4.3.1, 4.3.2, and 4.3.3, respectively.

4.3.1 Dioxin/Furan Analysis

All dioxin/furan analyses for Site WRI-A samples were performed by EMSL-RTP and ECL-Bay St. Louis, two of three EPA laboratories collectively referred to as Troika. The three Troika laboratories are ERL-Duluth, ECL-Bay St. Louis, and EMSL-Research Triangle Park.

Field samples requiring dioxin/furan analysis were prioritized based on their relative importance to the Tier 4 program objectives. The priority levels, in order of decreasing importance, were designated Priority 1 through Priority 3.

Priority 1 samples were sent to Troika with instructions to perform immediate extraction and analysis. These included the MM5 train components for the afterburner outlet exhaust stack sampling location, an MM5 field train blank, an MM5 proof train blank, field solvent blanks, primary chamber ash samples, and settling chamber ash samples.

Priority 2 samples were sent to Radian/RTP for archiving. These samples may be analyzed for dioxin/furan in the future, pending the results of the Priority 1 analyses. Priority 2 samples at Site WRI-A include feed samples taken for each test run.

Priority 3 samples included only the composite soil sample. The soil sample is being held by Radian's Research Triangle Park (RTP), N.C. laboratory pending evaluation of the Priority 1 and 2 analyses.

4.3.2 Dioxin/Furan Precursor Analysis

Dioxin/furan precursor analyses of incinerator feed samples were performed by Radian/RTP. The specific dioxin/furan precursors to be analyzed for included chlorophenols, chlorobenzenes, PCB's, total organic halogen (TOX), and total chlorine.

4.3.3 Total Chloride Analysis

Total chloride analysis was performed on front-half and back-half HCl train samples by Radian's Austin, Texas laboratory.

5.0 TEST RESULTS

The results of the Tier 4 dioxin/furan emissions testing of wire reclamation incinerator WRI-A are presented in this section.

A description of the sample periods and test runs is contained in Section 5.1. Process data obtained during the test runs are presented in Section 5.2, and flue gas parameter data are presented in Section 5.3.

The continuous monitoring results for O_2, CO, CO_2, NO_x, and THC are presented in Section 5.4. The dioxin/furan emissions data are contained in Section 5.5. Feed sample dioxin/furan precursor analyses are presented in Section 5.6, and auxiliary process sample analyses are presented in Section 5.7. Results of HCl train sampling are presented in Section 5.8.

5.1 DESCRIPTION OF TEST PERIODS

Six test runs were performed at Site WRI-A during the period March 19 through March 27, 1985. Three of the test runs were conducted during conditions of wire-only feed to the incinerator, and the other three test runs were conducted during conditions of wire and transformer feed. The overlap of the MM5/Dioxin, MM5/HCl, and CEM sampling periods with the tray charging history of the incinerator is represented in Figures 5-1 and 5-2.

Sampling was performed during all, or part of, at least three tray cycles for each test run. Complete tray cycles were sampled to the extent possible within the time constraints of the plant operating schedule and the sampling procedures. Sampling was not performed during the first feed cycle of each test day in order to allow the incinerator and afterburner temperatures to achieve quasi-steady state. Because of the variable batch nature of the process, the overlap of the sampling periods with the feed history of the incinerator was different for the individual test runs. A brief description of each test run is given below.

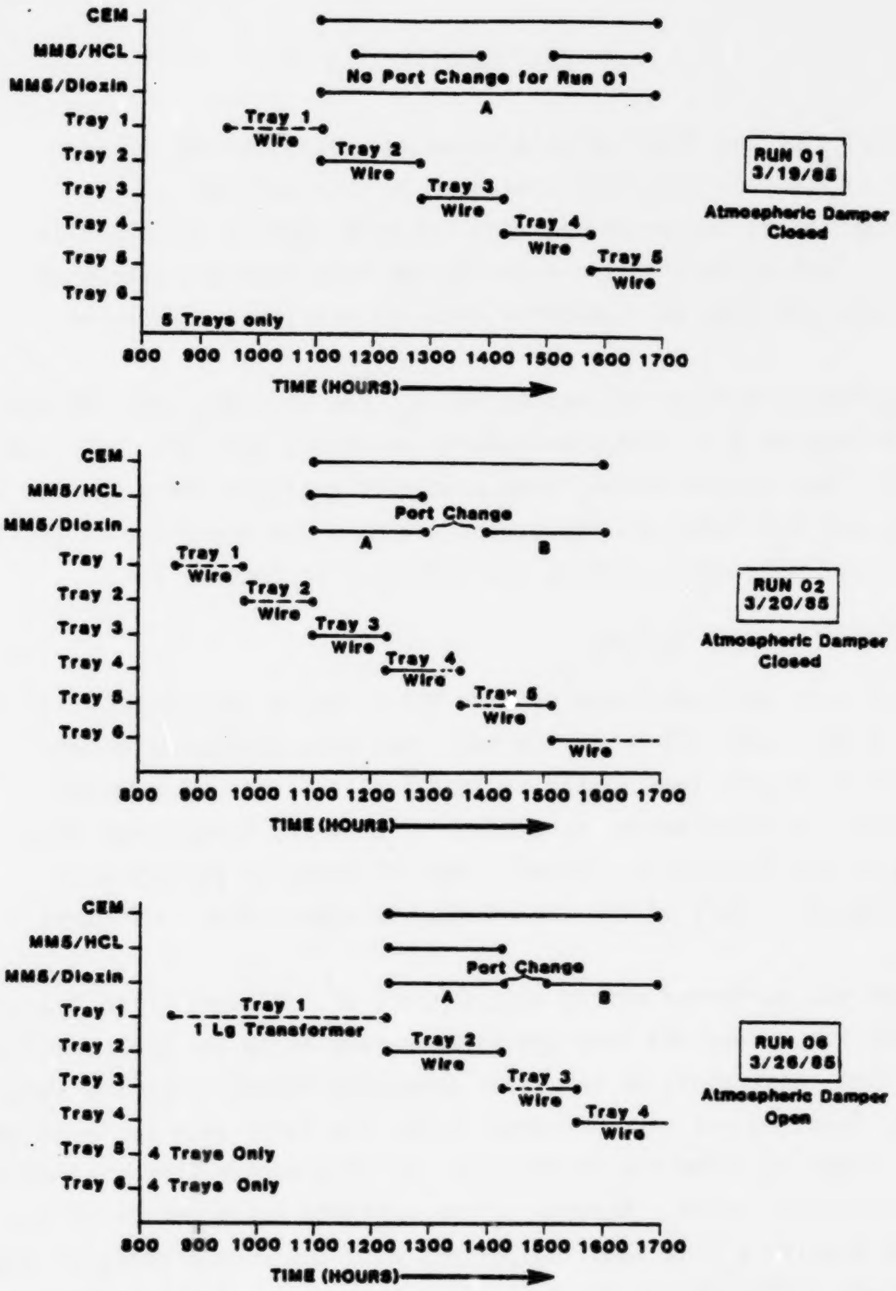


FIGURE 5-1. STACK SAMPLING AND INCINERATOR CHARGING HISTORIES FOR RUNS 01, 02, 06 (WIRE ONLY RUNS)

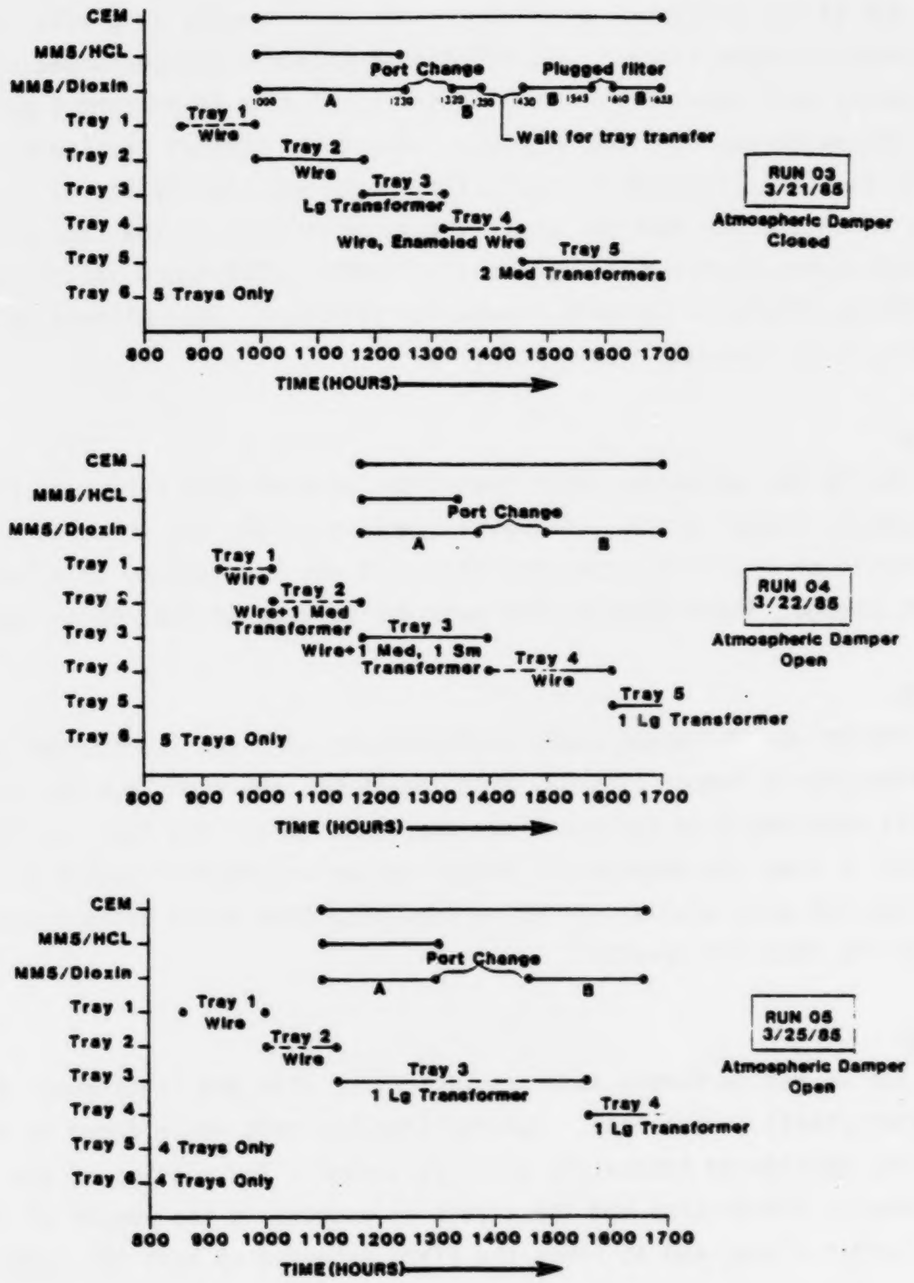


FIGURE 5-2. STACK SAMPLING AND INCINERATOR CHARGING HISTORIES FOR RUNS 03, 04, and 05 (WIRE & TRANSFORMER RUNS)

Run 01

Run 01 was performed under conditions of wire-only feed with the atmospheric damper closed. The MM5/dioxin traverse was performed using only one sample port because there was insufficient time to perform a port change with the water-cooled probe assembly. Using the largest available sampling nozzle (0.5 in), isokinetic sample flow rates were fairly low (0.25 cfm). In order to obtain the desired sample volume of 90 dscf in the time period that the host plant operated the incinerator (0900 - 1700 hours daily), it was decided to eliminate the port change for this run. This allowed an extra hour or more of on-line MM5/dioxin sampling.

Run 02

Run 02 was performed under conditions of wire-only feed with the atmospheric damper closed. A larger sampling nozzle was procured on-site, and the resulting isokinetic sampling flow rate was high enough to allow time for a port change. Port changes were made during each of Runs 02 through 06.

Run 03

Run 03 was performed under conditions of wire and transformer feed with the atmospheric damper closed. Plant personnel reported that the pink-colored opacity observed from the stack was atypical. After the test run it was decided to open the atmospheric damper on the afterburner outlet stack because this was the only unusual operating condition that could potentially have caused the observed opacity.

Run 04

Run 04 was performed under conditions of wire and transformer feed with the atmospheric damper open. Opacity from the unit was reduced to a level that was considered typical by plant personnel. The opening of the atmospheric damper also had the effect of increasing the length of the afterburner flame, and at times the flame extended up past the sample ports.

Run 05

Run 05 was performed under conditions of wire and transformer feed with the atmospheric damper open, identical to Run 04.

Run 06

Run 06 was performed under conditions of wire-only feed with the atmospheric damper open.

5.2 PROCESS DATA

Process data were collected to document incinerator and afterburner operation during the test runs. These data included a complete record of the feed cycle start/stop times, a complete record of tray weights before and after incineration, and a series of natural gas consumption measurements. In addition, temperatures were monitored at four locations: primary chamber, settling chamber, afterburner, and afterburner stack. An overview of the process data is given in Table 5-1, and more thorough discussions of the process rate data and temperature data are given below.

5.2.1 Process Rate Data

The feed cycle start/stop times and tray weight data obtained during each test period are listed in Table B-1 of Appendix B. From these discrete raw data, average hourly feed rates of bare metal, wire insulation, and transformer combustibles were developed for each test run. Table 5-2 summarizes the resulting process rate data. As used in this report, the term "total feed rate" represents the sum of the bare metal, wire insulation, and transformer combustibles feed rates. The term "total combustibles feed rate" represents the sum of the wire insulation and transformer combustibles feed rates.

The mean total feed rate during the wire-only runs (i.e. Runs 01, 02, and 06) was approximately 360 kg/hr (800 lb/hr), with a maximum between-run deviation of about 16%. The mean total combustibles feed rate (i.e., wire insulation feed rate) during these runs was approximately 45 kg/hr (100 lb/hr), with a maximum deviation of about 11%. Thus, the

TABLE 5-1. MEAN OPERATING DATA FOR INCINERATOR WRI-A DURING TEST PERIODS

Run Number	Feed Description	Atmospheric Damper	Total Feed Rate (lb/hr)	Combustibles Feed Rate (lb/hr)	% Combustibles from Transformers	Afterburner Temperature (^{o}F)
01	Wire Only	closed	925	89	0	ND
02	Wire Only	closed	778	109	0	2001
06	Wire Only	open	694	103	0	1859
Mean Runs 01,02,06	Wire Only	-	799	100	0	1930
03	Wire & Transformers	closed	846	144	70	1873
04	Wire & Transformers	open	800	110	54	1805
05	Wire & Transformers	open	427	156	88	1818
Mean Runs 03,04,05	Wire & Transformers	-	691	137	71	1832

Note: Data shown in units used by host plant.

- o To convert from lb/hr to kg/hr, multiply value in lb/hr by 0.454
- o To convert from ^{o}F to ^{o}C, use the equation $^{o}C = (^{o}F - 32)/1.8$

TABLE 5-2. SUMMARY OF MEAN PROCESS RATE DATA FOR INCINERATOR DURING WRI-A DURING TEST PERIODS

Run Number	Feed Description	Bare Metal Feed Rate (lb/hr)	Wire Insulation Feed Rate (lb/hr)	Transformer Combustibles Feed Rate (lb/hr)	Total Feed Rate (lb/hr)	Total Combustible Feed Rate (lb/hr)	% Total Combustibles from Transformers
01	Wire only	836	89	0	925	89	0
02	Wire only	669	109	0	778	109	0
06	Wire only	590	103	0	694	103	0
Mean Runs 01,02,06	Wire only	698	100	0	799	100	0
03	Wire & Transformers	702	43	101	846	144	70
04	Wire & Transformers	690	51	59	800	110	54
05	Wire & Transformers	371	19	137	427	156	88
Mean Runs 03,04,05	Wire & Transformers	588	38	99	691	137	71

Note: Data Shown in units used by host plant.

o To convert from lb/hr to kg/hr, multiply value in lb/hr by 0.454.

average feed rates to the incinerator were relatively constant for the wire-only test runs.

The mean total feed rate during the wire and transformer runs (i.e., Runs 03, 04, and 05) was approximately 310 kg/hr (690 lb/hr), with a maximum deviation of about 38%. The mean total combustibles feed rate (i.e., wire insulation and transformer combustibles feed rate) during these runs was approximately 65 kg/hr (140 lb/hr) with a maximum deviation of about 20%. Transformer combustibles represented about 70 percent of the total combustible materials fed to the incinerator, with a range of 54 to 88 percent. Thus, the feed rate data for the wire and transformer test runs show a higher degree of variability than the wire-only runs. The reason for this is that the transformers come in various sizes and designs, and the number of transformers per tray is small (1-3 transformers per tray). Thus, significant tray-to-tray differences exist when transformers and wire are fed to the incinerator, while the wire-only trays tend to be quite similar to each other.

5.2.2 Temperature Monitoring Data

Temperature histories were obtained at four monitoring locations during the test runs. Mean values for each run are summarized in Table 5-3. The mean temperature data show fairly good consistency between runs, particularly for the primary chamber and settling chamber locations. The mean primary chamber temperature for all test runs was approximately 560°C (1045°F), and the mean settling chamber temperature for all test runs was approximately 325°C (615°F). The afterburner temperatures showed more variability between runs. The mean afterburner temperature for all test runs was approximately 1030°C (1800°F), and the mean afterburner stack temperature was approximately 780°C (1440°F). It is difficult to generalize about temperature differences between wire-only and wire and transformer runs because of the confounding effect of the open/closed status of the atmospheric damper.

The within-run time/temperature histories for two test runs (Runs 01 and Run 04) are illustrated in Figures 5-3 and 5-4. The data for Run 01 most markedly show the effects of the tray feed cycle on incinerator temperatures. Each time the primary chamber doors were opened to feed or remove a tray from the incinerator, the primary chamber temperature dropped significantly from

TABLE 5-3. MEAN OPERATING TEMPERATURES FOR INCINERATOR WRI-A DURING THE TEST PERIODS

Run Number	Feed Description	Primary Chamber (^oF)	Settling Chamber (^oF)	Afterburner Location 1 (^oF)	Afterburner Location 2 (^oF)
01	Wire only	1087	609	ND	1543
02	Wire only	984	612	2001	1556
06	Wire only	1080	633	1859	1371
Mean Runs 01,02,06	Wire only	1050	618	1930	1490
03	Wire & Transformers	1080	634	1873	1511
04	Wire & Transformers	946	584	1805	1364
05	Wire & Transformers	1085	620	1818	1276
Mean Runs 03,04,05	Wire & Transformers	1037	613	1832	1384

Note: Data shown in units used by host plant.

- To convert from ^oF to ^oC, use the equation $^oC = (^oF - 32)/1.8$

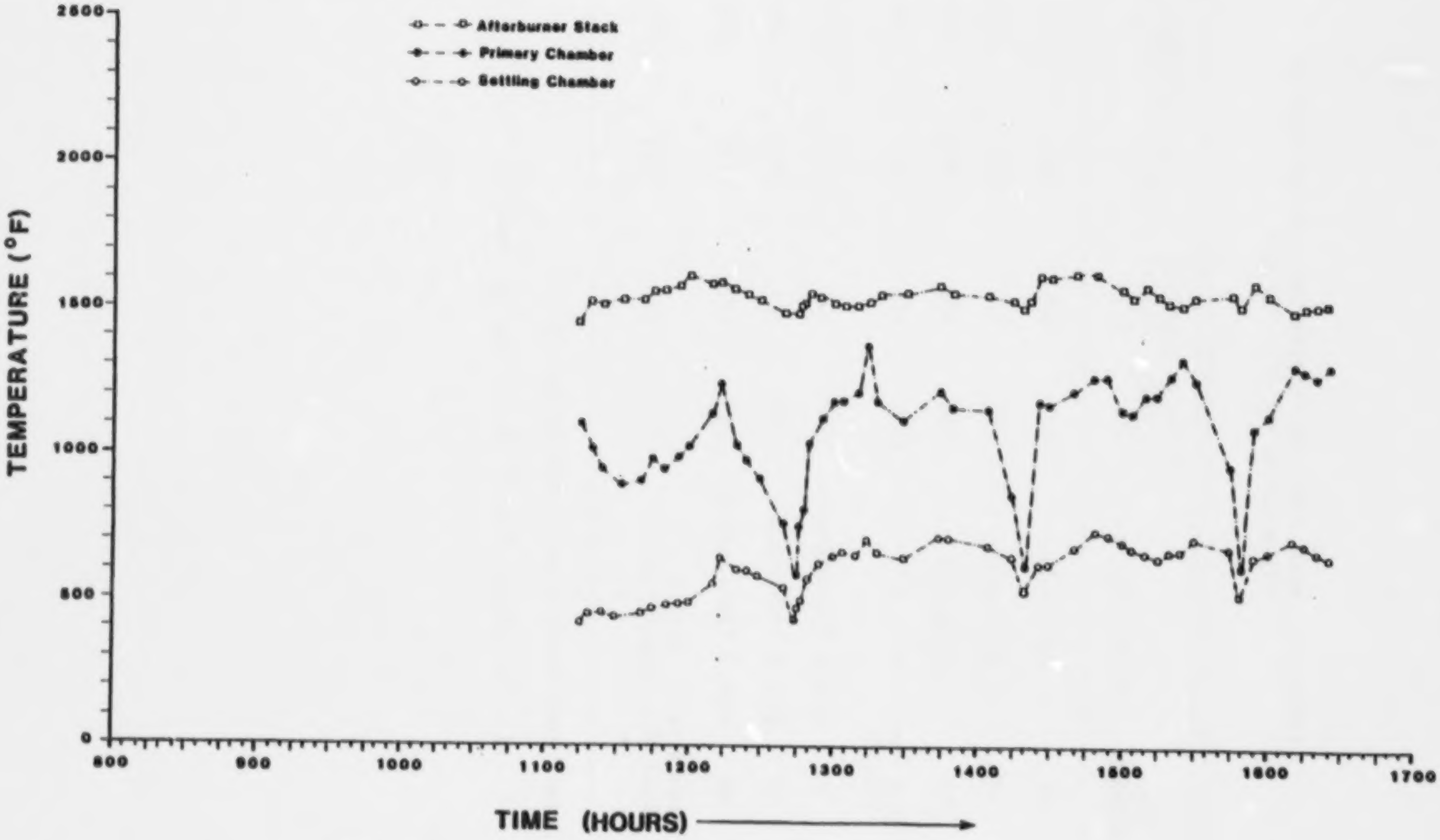


FIGURE 5-3. TEMPERATURE VS. TIME HISTORY FOR RUN 01

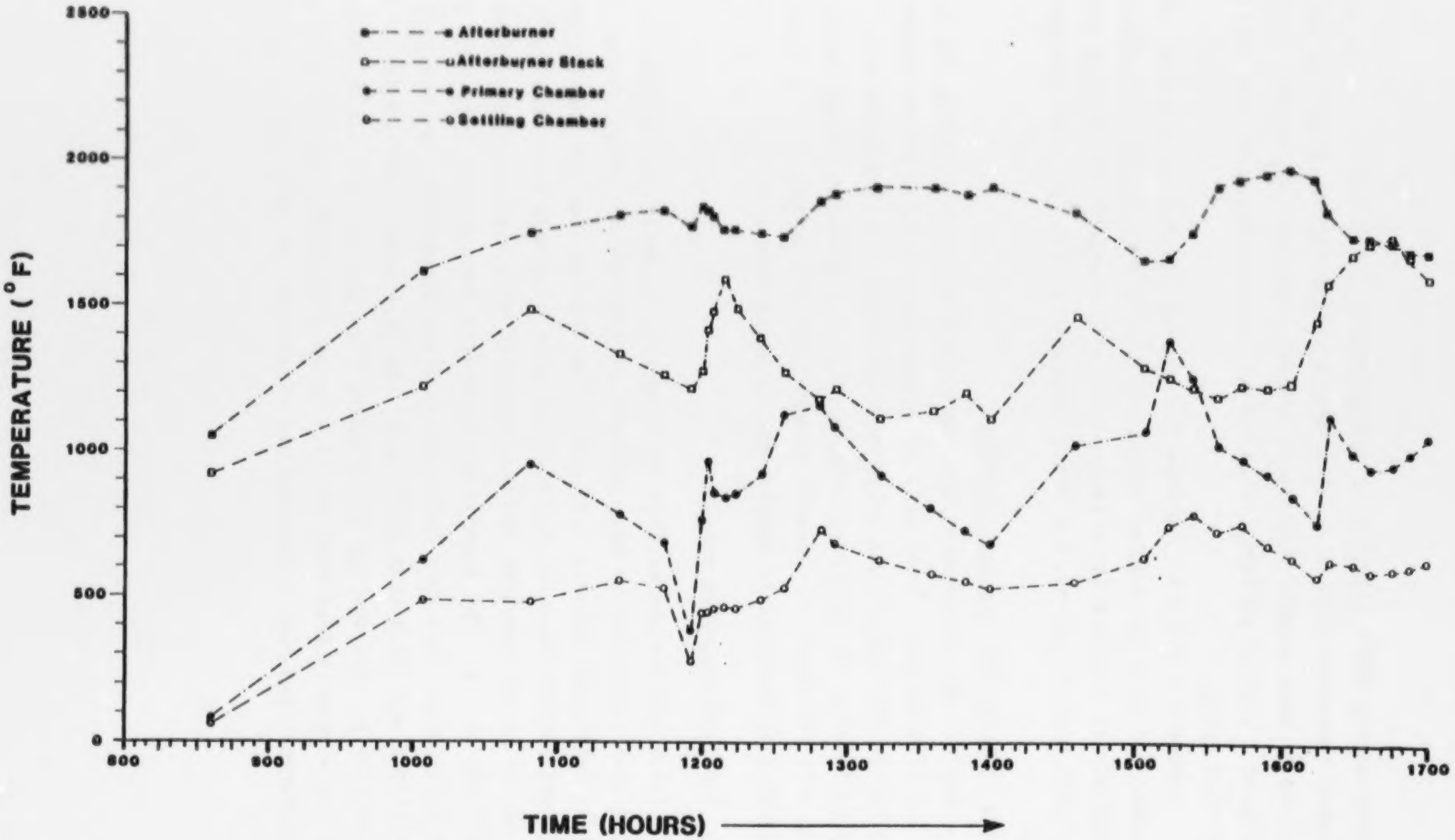


FIGURE 5-4. TEMPERATURE VS. TIME HISTORY FOR RUN 04

approximately 600°C (1100°F) to approximately 315°C (600°F). The primary chamber temperature would quickly recover after the new feed tray was charged and the primary chamber doors were closed. The settling chamber temperature followed a similar pattern. Afterburner temperatures were less sensitive to the feed cycle.

Figure 5-3 and 5-4 also show that during the course of a day, the primary chamber and settling chamber temperatures slowly increase. Afterburner temperatures increase for a period of 2 to 3 hours in the morning after the unit has been turned on, but these temperatures tend to level off during the day.

5.2.3 Natural Gas Consumption Data

Natural gas consumption data were taken daily to estimate the firing rate of the afterburner. These data are summarized in Table B-2 of Appendix B. Typically, the natural gas usage rate was about 0.6 cu meter/min (20 cu ft/min), which corresponds to about 1.2 MMBtu/hr energy input. The data were not taken at frequent enough intervals to make a firm conclusion regarding differences in natural gas usage between runs.

5.3 FLUE GAS PARAMETER DATA

Table 5-4 summarizes flue gas temperature, moisture, volumetric flowrate and oxygen concentration data obtained at Site WRI-A. These parameters were fairly consistent between test runs. The average flue gas temperature and moisture content measured for the runs with wire-only feed were 700°C and 13.4%, while the averages for the runs with wire and transformer feed were 652°C and 14.1 %. The average gas flowrates for the wire-only feed and wire and transformer feed runs under actual stack temperature and moisture conditions were 58.8 acmm (2076 acfm) and 59.1 acmm (2087 ascfm), respectively. The average dry standard flowrate was 15.1 dscmm (534 dscfm) for the wire-only feed runs and 15.7 dscmm (556 dscfm) for the wire and transformer feed runs. Standard EPA conditions are 20°C (68°F) and 1 atm.

TABLE 5-4. FLUE GAS PARAMETERS AT SITE WRI-A[a]

	Wire-Only Feed			Wire and Transformer Feed		
Flue Gas Parameter	Run 01	Run 02	Run 06	Run 03	Run 04	Run 05
Temperature (^{o}C)	684	706	709	637	667	651
Moisture (Vol %)	14.6	14.2	11.5	15.0	14.8	12.4
Volumetric Flowrate						
Actual (acmm)	55.6	59.4	61.4	54.6	58.3	64.4
Dry Standard (dscmm)	14.3	15.0	16.0	14.5	15.0	17.7
Oxygen Content						
Radian CEM (Vol%, dry)	4.4	3.7	8.9	5.2	6.8	10.3

---

[a] Metric units are reported for all the flue gas measurement data. To convert to alternate units: $^{o}F = 1.8\ (^{o}C) + 32$; cfm = cmm x 35.3.

5.4 CONTINUOUS EMISSIONS MONITORING DATA

Mean values and standard deviations of the continuously monitored combustion gases at the afterburner outlet location (O_2, CO, CO_2, NO_x, and THC) are shown for each MM5 test run in Table 5-5. The data show a fairly high degree of variability between runs for most of the gas species monitored.

Mean flue gas oxygen values for the three test runs conducted with the atmospheric damper closed (Runs 01, 02, 03) ranged from 3.7% O_2 to 5.2% O_2, with an average of 4.4% O_2. As expected, flue gas oxygen values were higher for runs with the atmospheric damper open than for runs with the atmospheric damper closed. This is due to the fact that the CEM sampling location was above (i.e., downstream of) the atmospheric damper, and the exhaust gas was diluted with ambient air when the atmospheric damper was open. The mean flue gas oxygen values for the three test runs conducted with the atmospheric damper open (Runs 04, 05, 06) ranged from 6.8% O_2 to 10.3% O_2, with an average of 8.7% O_2.

Mean carbon monoxide concentrations were found to be relatively high for all test runs, regardless of the feed type or the open/closed status of the atmospheric damper. The mean values (corrected to 3% O_2) ranged from approximately 3400 ppmv CO (Run 01) to 8000 ppmv CO (Run 05), with an average of 5100 ppmv CO for all runs. There is apparently no significant difference between CO emissions during wire-only feeding and wire & transformer feeding.

Total hydrocarbon concentrations were found to be highly variable between runs, with concentrations for wire-only runs (Runs 01, 02, 06) being lower than concentrations for wire and transformer runs (Runs 03, 04, 05). The mean total hydrocarbon concentration (corrected to 3% O_2) ranged from approximately 30 ppmv to 650 ppmv for wire-only runs, with a mean value of 280 ppmv. The mean values for wire & transformer runs ranged from approximately 350 ppmv to 1470 ppmv, with a mean value of 880 ppmv. These data are consistent with visual observations of opacity and hydrocarbon build-up on the sample train filters.

Five minute average concentration values for each of the continuously monitored combustion gases are tabulated in Appendix A-2 and are shown graphically as functions of time in Figures 5-5 through 5-14. These data show considerable short-term variations in each of the continuously monitored gas concentrations.

TABLE 5-5. MEAN VALUES AND STANDARD DEVIATIONS OF CONTINUOUSLY MONITORED COMBUSTION GASES AT THE AFTERBURNER EXHAUST LOCATION

Parameter[a,b,c]	Run 01	Run 02	Run 03	Run 04	Run 05	Run 06[d]
O_2 (% vol)	4.4 (2.7)	3.7 (2.8)	5.2 (3.0)	6.8 (3.3)	10.3 (1.9)	8.9 (3.2)
CO (ppmv @ 3% O_2)	3363.8 (2751.1)	3846.9 (2463.5)	4823.5 (3031.8)	3972.3 (3521.6)	8017.8 (3991.6)	6760.3 (5983.9)
CO_2 (% vol @ 3% O_2)	12.7 (1.6)	14.4 (1.8)	14.1 (2.6)	12.8 (2.0)	15.4 (3.0)	11.6 (0.7)
NO_x (ppmv @ 3% O_2)	77.4 (34.6)	101.2 (44.9)	52.4 (32.9)	136.8 (39.5)	189.0 (76.3)	N/A
THC (ppmv @ 3% O_2)	32.5 (45.3)	653.7 (615.6)	1474.2 (1486.1)	802.4 (1288.0)	355.9 (549.1)	143.2 (116.6)

---

[a] Gas sampling for the continuous monitors was performed at the afterburner exhaust outlet location.

[b] All concentrations expressed on a dry volume basis except for total hydrocarbon concentrations, which are expressed on a wet volume basis.

[c] Total hydrocarbon data are expressed in units of ppmv (wet) as propane.

[d] Total hydrocarbons were the only continuously monitored concentration during Run 06. The O_2, CO, and CO_2 data were developed from integrated bag samples analyzed using the Shimadzu GC.

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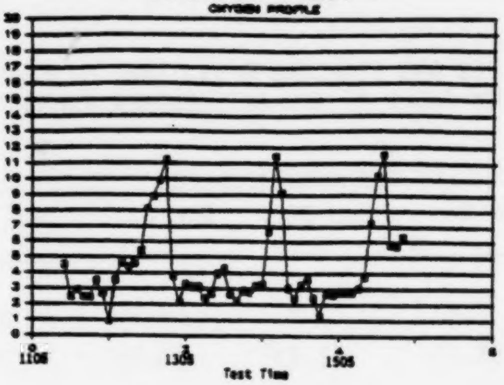
SITE 06 - TEST 1

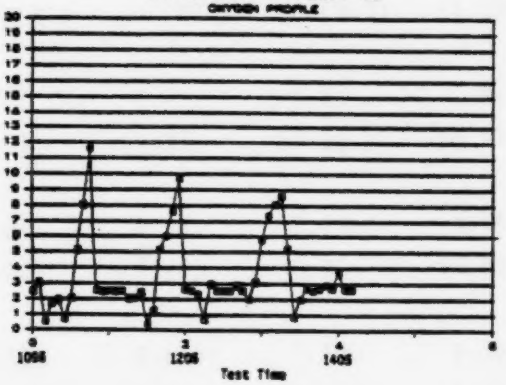
OXYGEN PROFILE



MEAN: 4.4% V O2
STD. DEV.: 2.7% V
INSTRUMENT RANGE: 0-25% V O2

SITE 06 - TEST 2

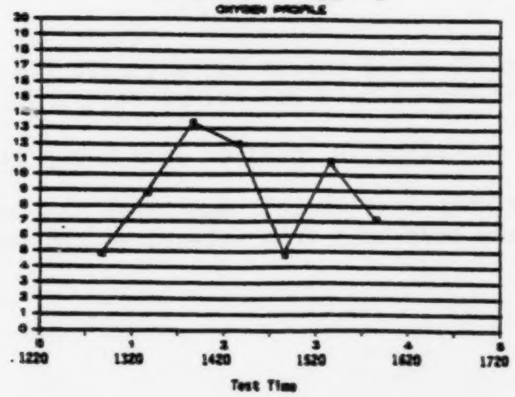
OXYGEN PROFILE



MEAN: 3.7% V O2
STD. DEV.: 2.8% V
INSTRUMENT RANGE: 0-25% V O2

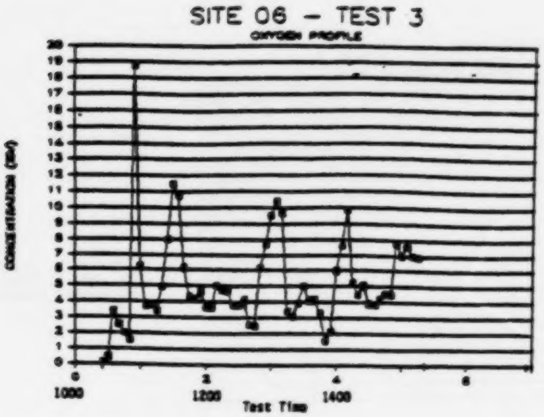
SITE 06 - TEST 6

OXYGEN PROFILE



MEAN: 8.9% V O2
STD. DEV.: 3.2% V
INSTRUMENT RANGE: 0-25% V O2

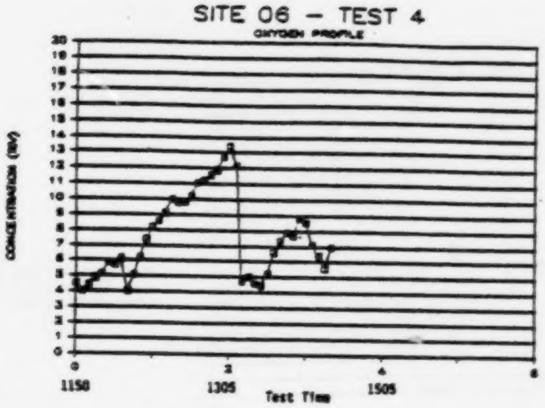
FIGURE 5-5. OXYGEN CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE ONLY RUNS)



SITE 06 - TEST 3

OXYGEN PROFILE

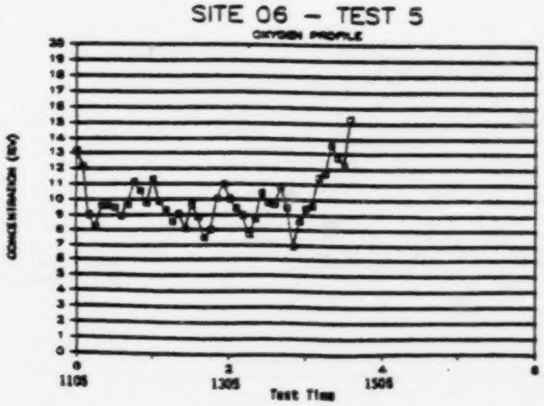
MEAN: 5.2% V O2
STD. DEV.: 3.8% V
INSTRUMENT RANGE: 0-25% V O2



SITE 06 - TEST 4

OXYGEN PROFILE

MEAN: 6.8% V O2
STD. DEV.: 3.3% V
INSTRUMENT RANGE: 0-25% V O2

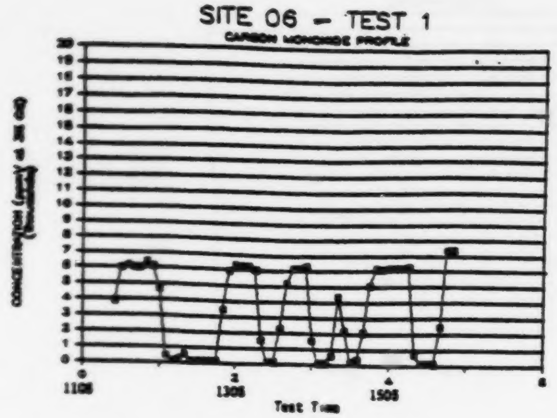


SITE 06 - TEST 5

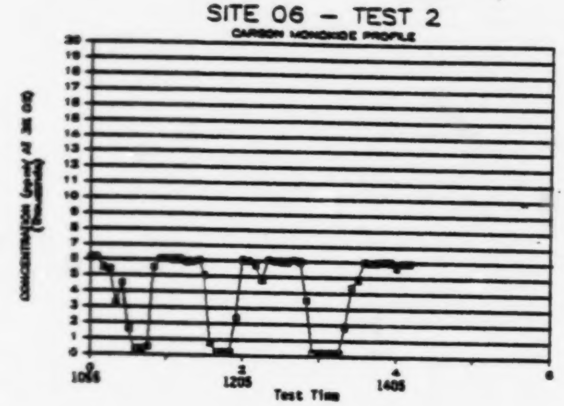
OXYGEN PROFILE

MEAN: 10.3% V O2
STD. DEV.: 1.9% V
INSTRUMENT RANGE: 0-25% V O2

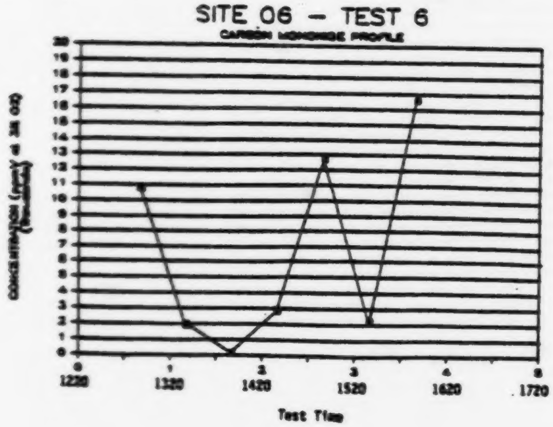
FIGURE 5-6. OXYGEN CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE & TRANSFORMER RUNS)



MEAN: 3363.8 ppmV CO @ 3% O2
STD. DEV.: 2751.1 ppmV
INSTRUMENT RANGE: 0-6000 ppmV CO

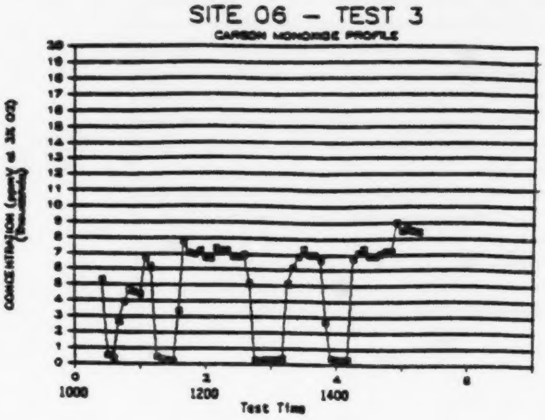


MEAN: 3846.9 ppmV CO @ 3% O2
STD. DEV.: 2463.3 ppmV
INSTRUMENT RANGE: 0-6000 ppmV CO

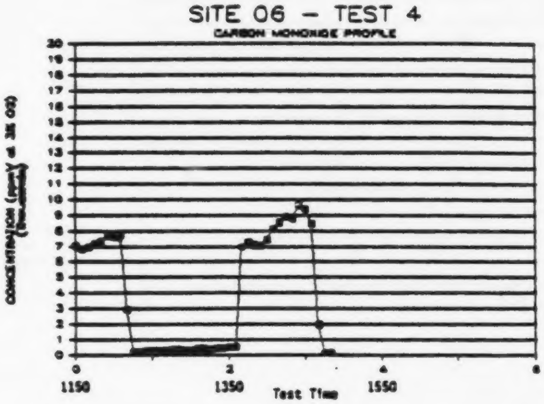


MEAN: 6768.3 ppmV CO @ 3% O2
STD. DEV.: 5983.9 ppmV
INSTRUMENT RANGE: 0-6000 ppmV CO

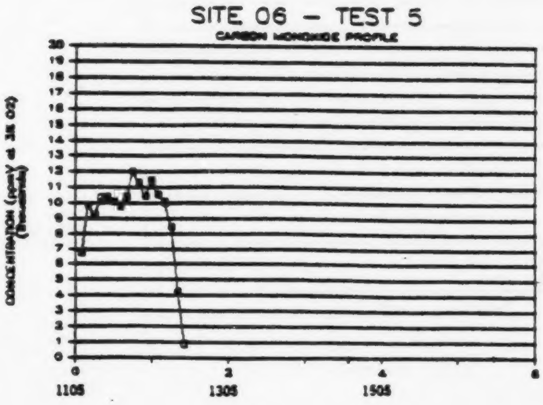
FIGURE 5-7. CARBON MONOXIDE CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE-ONLY RUNS)



MEAN: 4823.5 ppmv CO @ 3% O2
STD. DEV.: 3031.8 ppmv
INSTRUMENT RANGE: 0-6000 ppmv CO

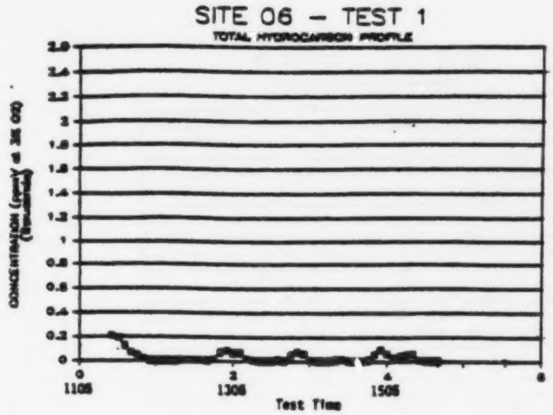


MEAN: 3972.3 ppmv CO @ 3% O2
STD. DEV.: 3321.6 ppmv
INSTRUMENT RANGE: 0-6000 ppmv

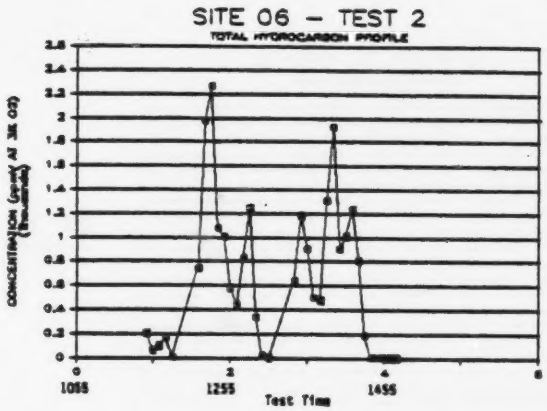


MEAN: 9817.8 ppmv CO @ 3% O2
STD. DEV.: 3991.6 ppmv
INSTRUMENT RANGE: 0-6000 ppmv CO

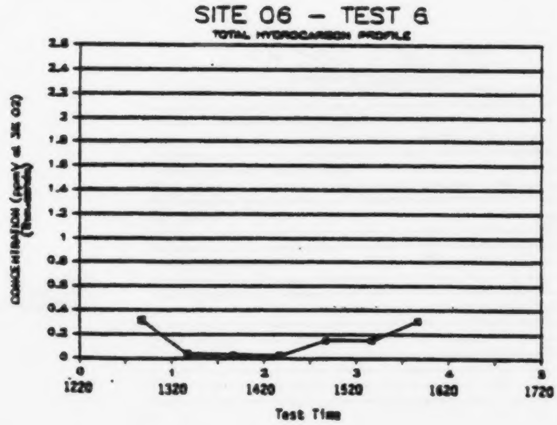
FIGURE 5-8. CARBON MONOXIDE CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE & TRANSFORMER RUNS)



MEAN: 32.3 ppmV THC @ 3% O2
STD. DEV.: 43.3 ppmV
INSTRUMENT RANGE: 0-500 ppmV THC

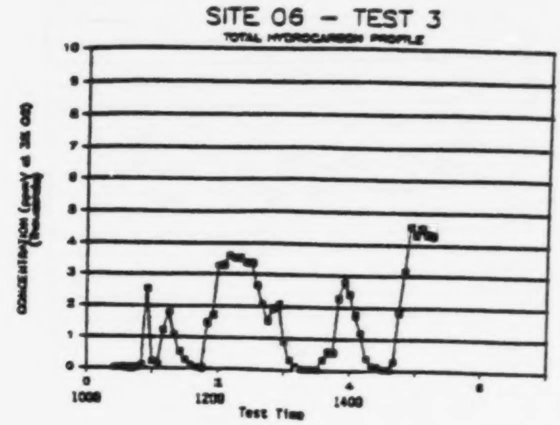


MEAN: 633.7 ppmV THC @ 3% O2
STD. DEV.: 615.6 ppmV
INSTRUMENT RANGE: 0-2500 ppmV THC



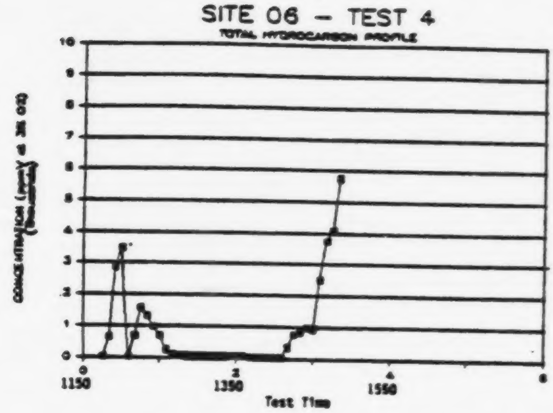
MEAN: 143.2 ppmV THC @ 3% O2
STD. DEV.: 116.6 ppmV
INSTRUMENT RANGE: 0-2500 ppmV THC

FIGURE 5-9. TOTAL HYDROCARBON CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE-ONLY RUNS)


SITE 06 - TEST 3

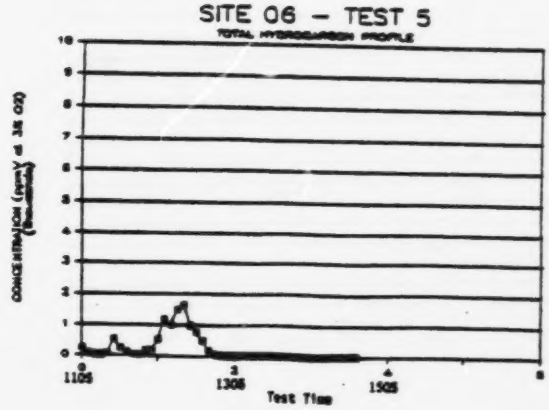
TOTAL HYDROCARBON PROFILE

MEAN: 1474.2 ppmv THC @ 3% O2
STD. DEV.: 1406.1 ppmv
INSTRUMENT RANGE: 0-10000 ppmv THC


SITE 06 - TEST 4

TOTAL HYDROCARBON PROFILE

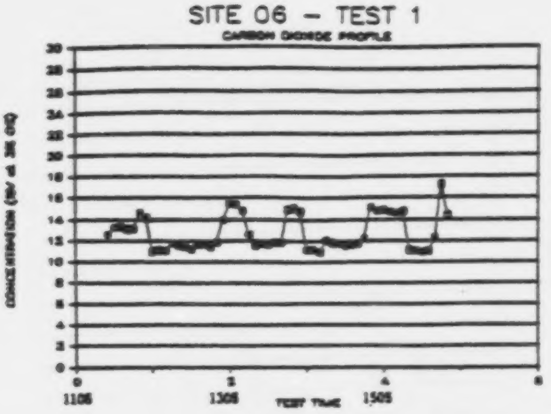
MEAN: 882.4 ppmv THC @ 3% O2
STD. DEV.: 1288.8 ppmv
INSTRUMENT RANGE: 0-10000 ppmv THC


SITE 06 - TEST 5

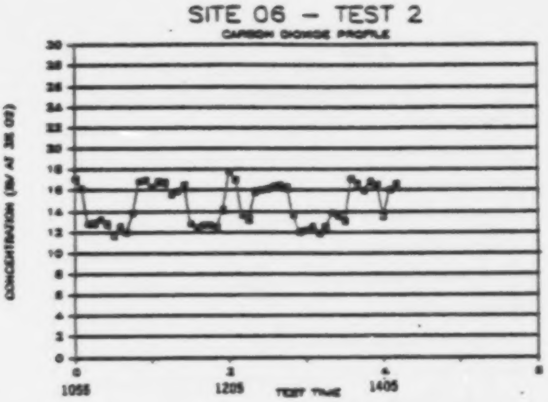
TOTAL HYDROCARBON PROFILE

MEAN: 333.9 ppmv THC @ 3% O2
STD. DEV.: 549.1 ppmv
INSTRUMENT RANGE: 0-2500 ppmv THC

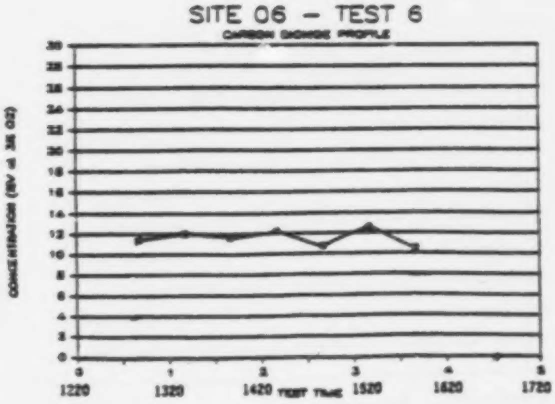
FIGURE 5-10. TOTAL HYDROCARBON CONCENTRATION
HISTORY AT THE AFTERBURNER OUTLET
LOCATION (WIRE & TRANSFORMER RUNS)



MEAN: 12.7% V CO2 @ 7% O2
STD. DEV.: 1.6% V
INSTRUMENT RANGE: 0-20% V CO2



MEAN: 14.4% V CO2 @ 7% O2
STD. DEV.: 1.8% V
INSTRUMENT RANGE: 0-20% V CO2



MEAN: 11.6% V CO2 @ 7% O2
STD. DEV.: 0.7% V
INSTRUMENT RANGE: 0-20% V CO2

FIGURE 5-11. CARBON DIOXIDE CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE-ONLY RUNS)

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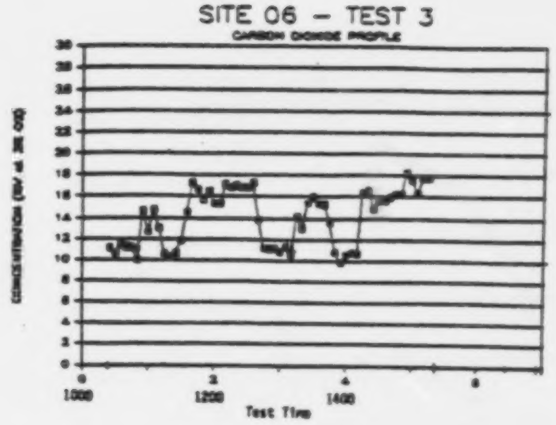
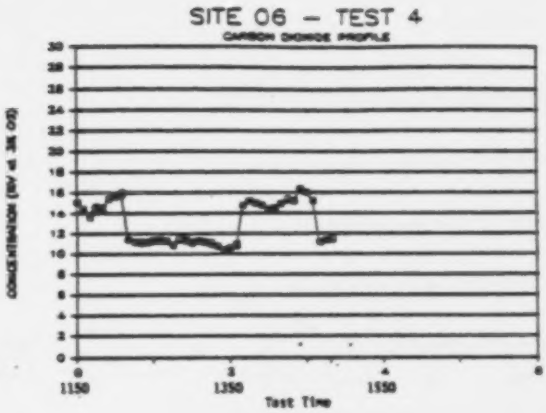
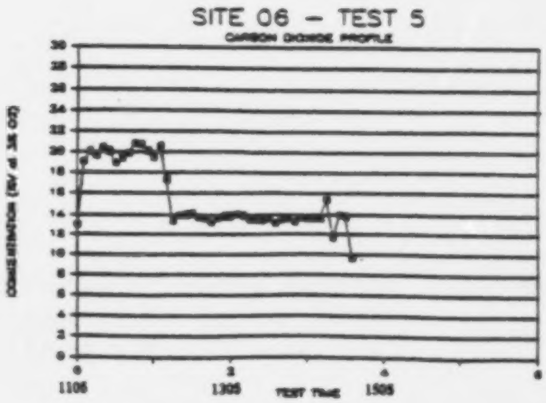


MEAN: 14.1% V CO2 @ 3% O2
STD. DEV.: 2.6% V
INSTRUMENT RANGE: 0-30% V CO2



MEAN: 12.8% V CO2 @ 3% O2
STD. DEV.: 2.0% V
INSTRUMENT RANGE: 0-30% V CO2



MEAN: 15.4% V CO2 @ 3% O2
STD. DEV.: 3.0% V
INSTRUMENT RANGE: 0-30% V CO2

FIGURE 5-12. CARBON DIOXIDE CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE & TRANSFORMER RUNS)

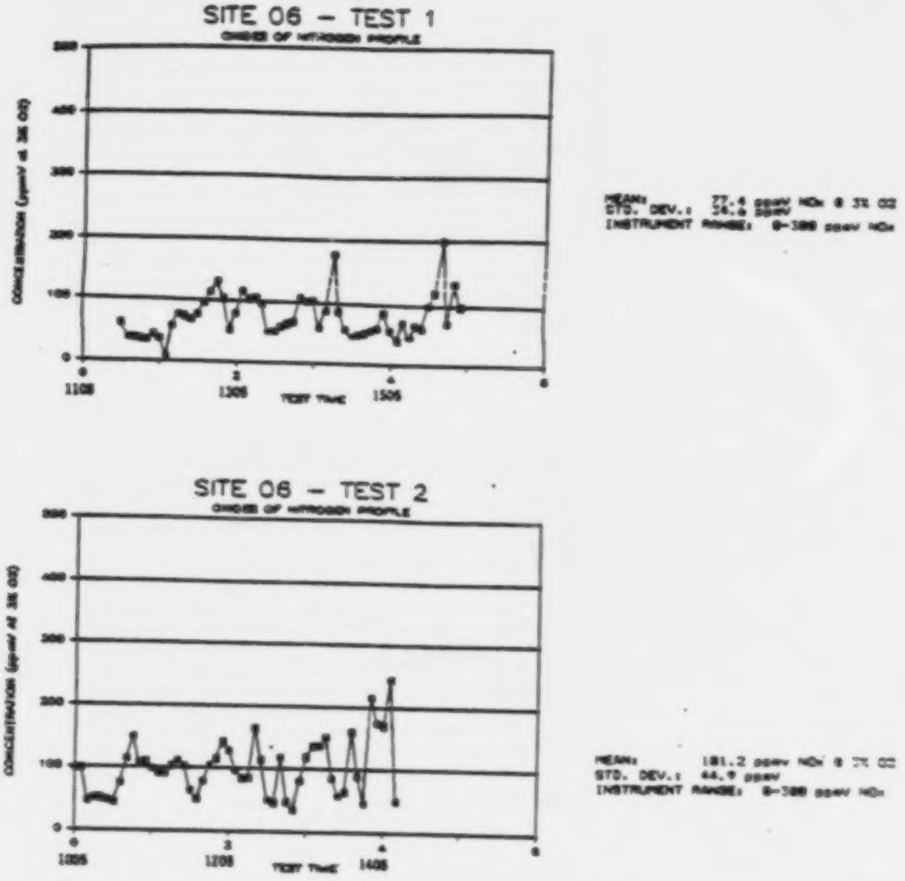
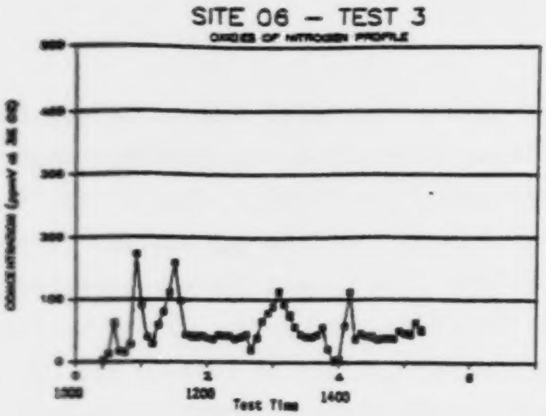
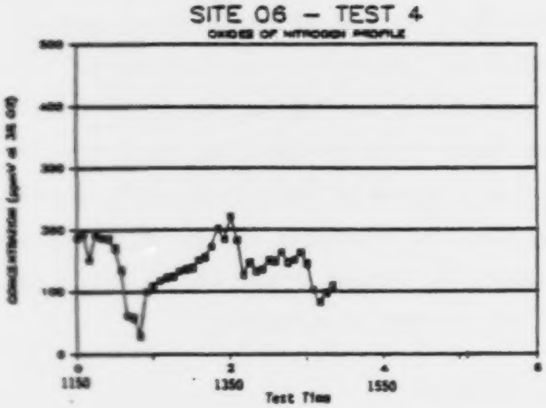


FIGURE 5-13. NITROGEN OXIDES CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE-ONLY RUNS)


SITE 06 – TEST 3

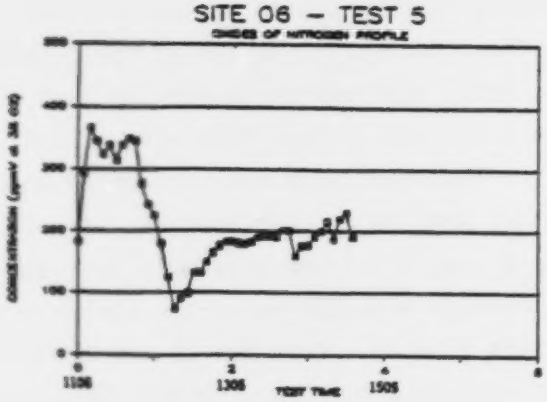
OXIDES OF NITROGEN PROFILE

MEAN: 52.4 ppmV NOx @ 3% O2
STD. DEV.: 32.9 ppmV
INSTRUMENT RANGE: 0-300 ppmV NOx


SITE 06 – TEST 4

OXIDES OF NITROGEN PROFILE

MEAN: 136.8 ppmV NOx @ 3% O2
STD. DEV.: 39.5 ppmV
INSTRUMENT RANGE: 0-300 ppmV NOx


SITE 06 – TEST 5

OXIDES OF NITROGEN PROFILE

MEAN: 189.8 ppmV NOx @ 3% O2
STD. DEV.: 76.3 ppmV
INSTRUMENT RANGE: 0-300 ppmV NOx

FIGURE 5-14. NITROGEN OXIDES CONCENTRATION HISTORY AT THE AFTERBURNER OUTLET LOCATION (WIRE & TRANSFORMER RUNS)

The time behavior of the monitored concentrations for runs with the atmospheric damper closed (Runs 01-03) is different than that for runs with the atmopsheric damper open (Runs 04-06). Runs 01-03 show a distinctly cyclical behavior, particularly in flue gas oxygen, carbon monoxide, and total hydrocarbon concentrations. The CO and THC concentrations show typical inverse relationships with flue gas oxygen. When the flue gas oxygen concentration is high, concentrations of both CO and THC become small, and vice versa. Thus, when excess oxygen is high, combustion is more complete in the afterburner. The measured variability in flue gas oxygen concentrations is attributable to the batch nature of the process and to the irregular adjustments of combustion air made by plant personnel.

In general, the continuous monitoring data for Runs 04-06 (atmospheric damper open) show less short term variability than that for Runs 01-03. Large changes in measured values occurred less frequently during Runs 04-06. The most likely reason for this is that the incinerator has a more stable draft behavior with the atmospheric damper open, which leads to less short-term excess oxygen variability in the afterburner.

5.5 DIOXIN/FURAN EMISSIONS DATA

This section presents the dioxin/furan emissions data measured at the afterburner outlet exhaust stack. Due to analytical difficulties, results were not reported for the complete set of target homologues for all test runs. Average total PCDD and total PCDF emissions for the test runs were calculated by summing the average emissions of each homologue. Test runs where data were not reported for a given homologue were not considered when calculating the average emissions of that homologue. For example, hexa-CDD analytical data were reported for Runs 01 and 06 of the wire-only feed set, but were not reported for Run 02. Average hexa-CDD emissions for wire-only feed runs were calculated as the average of values from Run 01 and 02 only.

Section 5.5.1 presents data for the wire-only feed runs (Runs 01, 02, and 06), and Section 5.5.2 presents data for the wire and transformer feed runs (Runs 03, 04, and 05).

5.5.1 Wire-Only Feed Runs (Runs 01, 02 and 06)

Emission concentrations and emission rate data for the wire-only feed runs are shown in Table 5-6 and 5-7 for the 2378-TCDD, total PCDD, and total

PCDF species. The data include dioxin and furan collected in the entire MM5 train, including filter, XAD sorbent trap, impingers, and sample train clean-up rinses. Data are not available for some isomers due to contamination of the sample extracts. This contamination led to low recovery efficiencies for some isomers. As a result, in the following sections it will be noted that for some isomer-specific analyses, the results were not reported by Troika. In any case, the analyses indicated that the 2378 isomers are less than 25 percent of the respective total TCDD and TCDF concentrations.

Average as-measured emissions concentrations of the 2378-TCDD, total PCDD, and PCDF species were 0.093 ng/dscm 2378-TCDD; 124 ng/dscm total PCDD; and 225 ng/dscm total PCDF. When corrected to 3% O_2 using the Radian CEM oxygen concentration data, these values correspond to 0.138 ng/dscm @ 3% O_2; 173 ng/dscm @ 3% O_2; and 305 ng/dscm @ 3% O_2, respectively. Average emission rates for the three species were 0.09 ug/hr 2378-TCDD, 114 ug/hr total PCDD, and 205 ug/hr total PCDF. Comparison of data reported for individual wire-only feed test runs indicates that dioxin/furan emissions for Run 06 were considerably higher than emissions for Runs 01 and 02. The primary operating difference between Run 06 and Runs 01/02 was that the atmospheric damper was open for Run 06 and closed for Runs 01 and 02, However, this does not appear to be responsible for the difference in the measured emissions because the same trend was not observed for the wire and transformer feed runs (see Section 5.5.2).

Isomer- and homologue-specific emission concentration data are summarized in Tables 5-8 and 5-9 for the three wire-only feed test runs. Run-specific data tables showing homologue emission concentrations in both ng/dscm and parts-per-trillion units and homologue emission rates in ug/hr units are included in Appendix D.

Figure 5-15 is a histogram that shows the relative distributions of the 2378-TCDD/TCDF isomers and the tetra-through octa PCDD/PCDF homologues in the emissions (mole basis). Homologues for which analytical data were not reported by Troika for Runs 01 and 02 were assigned zeroes for their contribution to the total PCDD and total PCDF emissions, although these homologues may actually have been present in the flue gas stream. Run 06 was the wire-only feed run for which a complete set of analytical data were reported by Troika. The hepta- and octa-chlorinated homologues were the primary dioxin species present in the Run 06 samples, accounting for 50 and 45

TABLE 5-6. OVERVIEW OF DIOXIN/FURAN EMISSIONS CONCENTRATION DATA FOR SITE WRI-A (WIRE FEED ONLY)

Run Number	2378 TCDD	Total PCDD	Total PCDF
Emissions Concentration (as measured), ng/dscm			
Run 01	NR	51	96
Run 02	NR	34	103
Run 06	0.093	277	457
Average	0.093	124	225
Emissions Concentration (corrected to 3% O_2), ng/dscm @ 3% O_2			
Run 01	NR	55	104
Run 02	NR	35	107
Run 06	0.138	412	680
Average	0.138	173	305

NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.

TABLE 5-7. SUMMARY OF DIOXIN AND FURAN EMISSIONS RATE DATA FOR SITE WRI-A (WIRE FEED ONLY)

	Dioxin/Furan Emission Rate, ug/hr		
Run Number	2378 TCDD	Total PCDD	Total PCDF
Run 01	NR	44	82
Run 02	NR	31	93
Run 06	0.089	266	439
Average	0.089	114	205

NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.

TABLE 5-8. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE WRI-A (WIRE FEED ONLY) (As-measured concentration)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm) Run 01	Run 02	Run 06	Avg.
DIOXINS				
2378 TCDD	NR	NR	9.29E-02	9.29E-02
Other TCDD	5.16E-01	NR	1.24E+00	8.78E-01
Penta-CDD	NR	NR	2.04E+00	2.04E+00
Hexa-CDD	3.10E+00	NR	8.82E+00	5.96E+00
Hepta-CDD	3.18E+01	2.15E+01	1.39E+02	6.41E+01
Octa-CDD	1.54E+01	1.24E+01	1.26E+02	5.13E+01
Total PCDD	5.09E+01	3.39E+01	2.77E+02	1.24E+02
FURANS				
2378 TCDF	NR	NR	3.72E-01	3.72E-01
Other TCDF	3.89E+00	9.63E+00	1.63E+01	9.94E+00
Penta-CDF	5.28E+00	NR	2.66E+01	1.59E+01
Hexa-CDF	1.23E+01	3.18E+00	6.06E+01	2.54E+01
Hepta-CDF	4.74E+01	6.12E+01	2.54E+02	1.21E+02
Octa-CDF	2.70E+01	2.92E+01	9.97E+01	5.20E+01
Total PCDF	9.58E+01	1.03E+02	4.57E+02	2.25E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.
NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.
ND = Not detected (detection limit in parentheses)
ng = 1.0E-09g
2080 operating hours per year

TABLE 5-9. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE WRI-A (WIRE FEED ONLY) (Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm @ 3% oxygen)			
	Run 01	Run 02	Run 06	Avg.
DIOXINS				
2378 TCDD	NR	NR	1.38E-01	1.38E-01
Other TCDD	5.59E-01	NR	1.84E+00	1.20E+00
Penta-CDD	NR	NR	3.04E+00	3.04E+00
Hexa-CDD	3.36E+00	NR	1.31E+01	8.23E+00
Hepta-CDD	3.45E+01	2.24E+01	2.07E+02	8.79E+01
Octa-CDD	1.67E+01	1.29E+01	1.87E+02	7.24E+01
Total PCDD	5.52E+01	3.53E+01	4.12E+02	1.73E+02
FURANS				
2378 TCDF	NR	NR	5.53E-01	5.53E-01
Other TCDF	4.22E+00	1.00E+01	2.42E+01	1.28E+01
Penta-CDF	5.72E+00	NR	3.96E+01	2.27E+01
Hexa-CDF	1.33E+01	3.31E+00	9.02E+01	3.56E+01
Hepta-CDF	5.14E+01	6.37E+01	3.78E+02	1.64E+02
Octa-CDF	2.93E+01	3.04E+01	1.48E+02	6.93E+01
Total PCDF	1.04E+02	1.07E+02	6.80E+02	3.05E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.
NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.
ND = Not detected (detection limit in parentheses)
ng = 1.0E-09g
2080 operating hours per year

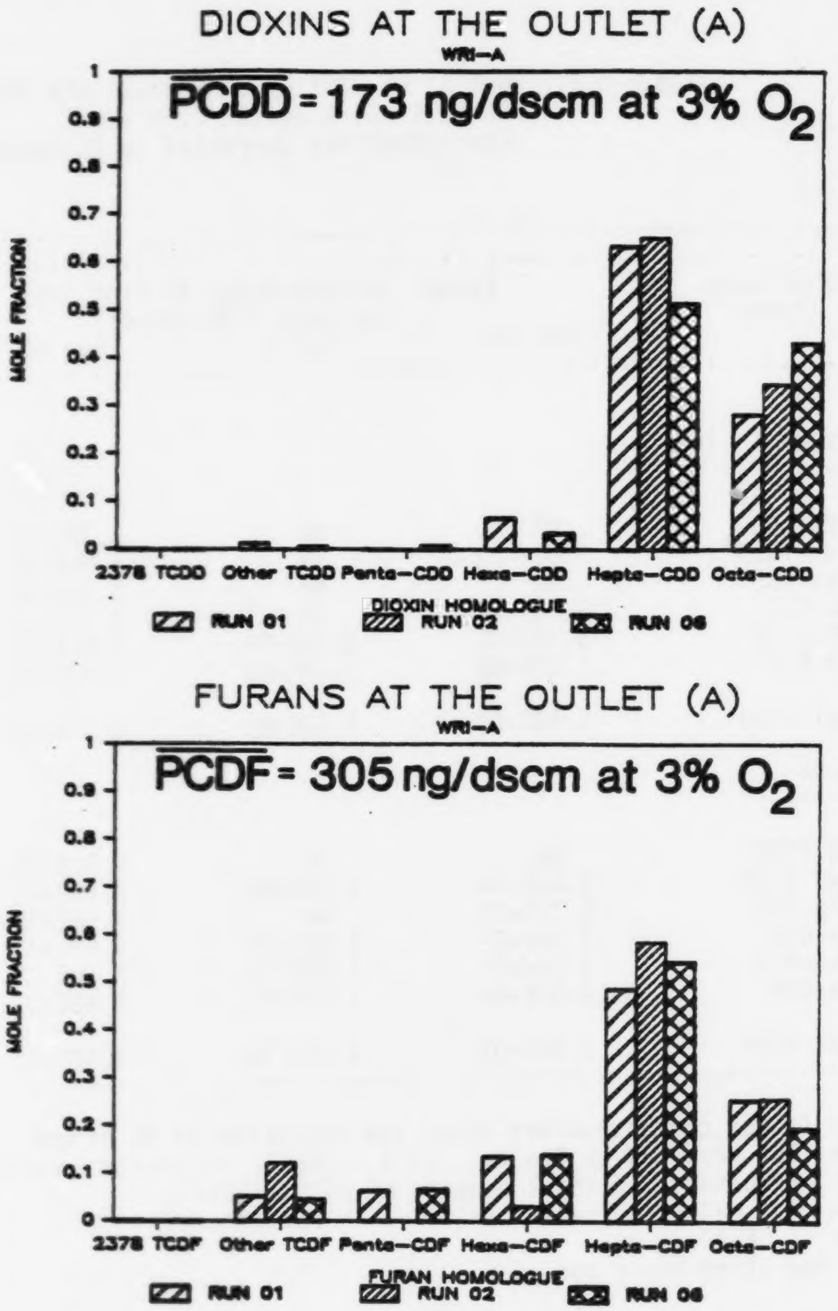


Figure 5-15. Dioxin/furan homologue distribution for the wire feed runs at Site WRI-A.

percent of the total PCDD, respectively. Furan emissions were somewhat more evenly distributed among the various homologues but the hepta- and octa-chlorinated homologues were again the predominant species.

Emission factors based on the total incinerator feed rate (i.e., metals and combustibles) for the afterburner outlet at site WRI-A are shown in Table 5-10. Average emission factors for 2378-TCDD, total PCDD, and total PCDF were 0.0002 ug 2378-TCDD emitted per kg total feed; 0.36 ug total PCDD emitted per kg total feed; and 0.63 ug total PCDF emitted per kg total feed. Emission factors for the various dioxin and furan homologues varied considerably between runs.

5.5.2 Wire and Transformer Feed Runs (Runs 03, 04 and 05)

Emission concentrations and emission rate data for the wire and transformer feed runs are shown in Tables 5-11 and 5-12 for the 2378-TCDD, total PCDD, and total PCDF species. The data include dioxin and furan collection in the entire MM5 train, including filter, primary XAD sorbent trap, impingers, and sample train clean-up rinses.

Average as-measured emissions concentrations of the 2378-TCDD, total PCDD, and PCDF species were 0.083 ng/dscm 2378-TCDD; 605 ng/dscm total PCDD; and 715 ng/dscm total PCDF. When corrected to 3% O_2 using the Radian CEM oxygen concentration data, these values correspond to 0.13 ng/dscm @ 3% O_2, 705 ng/dscm @ 3% O_2, and 866 ng/dscm @ 3% O_2, respectively. Average emission rates for the three species were 0.08 ug/hr 2378-TCDD, 520 ug/hr total PCDD, and 630 ug/hr total PCDF. Dioxin/furan emissions were considerable higher for Run 03 than for Runs 04 and 05. The primary operating difference between Run 03 and Runs 04 and 05 was that the atmospheric damper was closed for Run 03 and open for Runs 04 and 05. As noted in Section 5.1, the open/closed status of the atmospheric damper had a marked effect on the opacity from the incinerator under the wire and transformer feed conditions. The higher opacity observed for Run 03 was consistent with the higher THC and dioxin/furan emissions relative to Runs 04 and 05.

Isomer- and homologue specific emission concentration data are summarized in Tables 5-13 and 5-14 for the three wire and transformer feed test runs. Run-specific data tables showing homologue emission concentrations in both

TABLE 5-10. DIOXIN/FURAN EMISSION FACTORS FOR SITE WRI-A (WIRE FEED ONLY)

Dioxin/Furan Isomer	Dioxin/Furan Emission Factors (ug/kg)			
	Run 01	Run 02	Run 06	Avg.
DIOXINS				
2378 TCDD	NR	NR	2.83E-04	2.83E-04
Other TCDD	1.05E-03	NR	3.77E-03	2.41E-03
Penta-CDD	NR	NR	6.23E-03	6.23E-03
Hexa-CDD	6.32E-03	NR	2.69E-02	1.66E-02
Hepta-CDD	6.50E-02	5.49E-02	4.24E-01	1.81E-01
Octa-CDD	3.15E-02	3.15E-02	3.84E-01	1.49E-01
Total PCDD	1.04E-01	8.64E-02	8.45E-01	3.56E-01
FURANS				
2378 TCDF	NR	NR	1.13E-03	1.13E-03
Other TCDF	7.94E-03	2.46E-02	4.96E-02	2.74E-02
Penta-CDF	1.08E-02	NR	8.10E-02	4.59E-02
Hexa-CDF	2.50E-02	8.11E-03	1.85E-01	7.26E-02
Hepta-CDF	9.68E-02	1.56E-01	7.74E-01	3.42E-01
Octa-CDF	5.51E-02	7.45E-02	3.04E-01	1.44E-01
Total PCDF	1.96E-01	2.63E-01	1.39E+00	6.33E-01

NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.
ND = not detected (detection limit in parentheses).
ug = 1.0E-06g
2080 operating hours per year

Note: Emission factors are based on the total feed rate to the incinerator (i.e., metal and combustibles).

TABLE 5-11. OVERVIEW OF DIOXIN AND FURAN EMISSIONS CONCENTRATION DATA FOR SITE WRI-A (WIRE AND TRANSFORMER FEED)

Run Number	2378 TCDD	Total PCDD	Total PCDF
Emissions Concentration (as measured), ng/dscm			
Run 03	0.051	1610	1450
Run 04	NR	126	493
Run 05	0.115	50	164
Average	0.083	605	715
Emissions Concentration (corrected to 3% O_2), ng/dscm @ 3% O_2			
Run 03	0.058	1830	1650
Run 04	NR	160	625
Run 05	0.194	83	276
Average	0.126	705	866

NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.

TABLE 5-12. SUMMARY OF DIOXIN AND FURAN EMISSIONS RATE DATA FOR SITE WRI-A (WIRE AND TRANSFORMER FEED)

Run Number	Dioxin/Furan Emission Rate, ug/hr		
	2378 TCDD	Total PCDD	Total PCDF
Run 03	0.045	1400	1260
Run 04	NR	113	444
Run 05	0.122	53	174
Average	0.084	522	626

NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.

TABLE 5-13. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE WRI-A (WIRE AND TRANSFORMER FEED) (As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm)			
	Run 03	Run 04	Run 05	Avg.
DIOXINS				
2378 TCDD	5.12E-02	NR	1.15E-01	8.31E-02
Other TCDD	2.30E-01	1.32E+00	1.53E+00	1.03E+00
Penta-CDD	4.27E+00	NR	3.23E+00	3.75E+00
Hexa-CDD	4.95E+01	NR	5.50E+00	2.75E+01
Hepta-CDD	3.41E+02	6.19E+01	2.07E+01	1.41E+02
Octa-CDD	1.21E+03	6.27E+01	1.84E+01	4.32E+02
Total PCDD	1.61E+03	1.26E+02	4.95E+01	6.05E+02
FURANS				
2378 TCDF	4.09E-01	NR	8.07E-01	6.08E-01
Other TCDF	2.59E+01	5.42E+01	2.15E+01	3.39E+01
Penta-CDF	5.46E+01	NR	1.29E+01	3.38E+01
Hexa-CDF	1.77E+02	3.78E+01	2.10E+01	7.85E+01
Hepta-CDF	3.86E+02	2.65E+02	6.17E+01	2.38E+02
Octa-CDF	8.08E+02	1.37E+02	4.61E+01	3.30E+02
Total PCDF	1.45E+03	4.93E+02	1.64E+02	7.15E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.
NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.
ND = Not detected (detection limit in parentheses)
ng = 1.0E-09g
2080 operating hours per year

TABLE 5-14. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE WRI-A (WIRE AND TRANSFORMER FEED) (Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm @ 3% oxygen)			
	Run 03	Run 04	Run 05	Avg.
DIOXINS				
2378 TCDD	5.83E-02	NR	1.94E-01	1.26E-01
Other TCDD	2.62E-01	1.68E+00	2.57E+00	1.50E+00
Penta-CDD	4.87E+00	NR	5.43E+00	5.15E+00
Hexa-CDD	5.64E+01	NR	9.26E+00	3.28E+01
Hepta-CDD	3.89E+02	7.85E+01	3.48E+01	1.67E+02
Octa-CDD	1.38E+03	7.95E+01	3.10E+01	4.98E+02
Total PCDD	1.83E+03	1.60E+02	8.32E+01	7.05E+02
FURANS				
2378 TCDF	4.66E-01	NR	1.36E+00	9.13E-01
Other TCDF	2.95E+01	6.86E+01	3.61E+01	4.48E+01
Penta-CDF	6.22E+01	NR	2.17E+01	4.20E+01
Hexa-CDF	2.01E+02	4.79E+01	3.52E+01	9.48E+01
Hepta-CDF	4.40E+02	3.35E+02	1.04E+02	2.93E+02
Octa-CDF	9.21E+02	1.73E+02	7.75E+01	3.90E+02
Total PCDF	1.65E+03	6.25E+02	2.76E+02	8.66E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.
NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.
ND = Not detected (detection limit in parentheses)
ng = 1.0E-09g
2080 operating hours per year

ng/dscm and parts-per-trillion units and homologue emission rates in ug/hr units are included in Appendix D. Figure 5-16 is a histogram that shows the relative distributions of the 2378-TCDD/TCDF isomers and the tetra- through octa PCDD/PCDF homologues in the emissions (mole basis). Homologues for which analytical data were not reported by Troika for Run 04 were assigned zeroes for their contribution to the total PCDD and PCDF emissions, although these homologues may actually have been present in the flue gas stream.

The hepta- and octa-chlorinated homologues were the primary dioxin/furan species present in the samples with smaller but measureable quantities of the tetra- through hexa species also present. In general, the furan emissions were more evenly distributed among the various homologues than the dioxin emissions.

Emission factors for the wire and transformer feed runs are shown in Table 5-15. Average emission factors for 2378-TCDD, total PCDD, and total PCDF were 0.0004 ug 2378-TCDD emitted per kg of total feed, 1.4 ug total PCDD emitted per kg total feed, and 1.8 ug total PCDF emitted per kg total feed, respectively.

5.5.3 Comparison of Wire-Only Feed vs. Wire and Transformer Feed Runs

Table 5-16 compares the as-measured dioxin and furan concentrations and emission rates for the wire-only feed runs to the corresponding data for the wire and transformer feed runs. The data show considerable scatter, and it is difficult to generalize which feed material had higher emissions. Runs 03, which showed tha highest emissions of any test run, was a wire and transformer feed run.

5.6 INCINERATOR FEED PRECURSOR DATA

As discussed in Section 4.3.2, the incinerator feed was sampled at Site WRI-A. Two representative samples were taken for the 6 runs. One was a sample of the combustibles from the wire only feed while the second sample included combustibles from the wire and transformer feed. These samples were analyzed for chlorinated benzenes, chlorinated biphenyls, and chlorinated phenols.

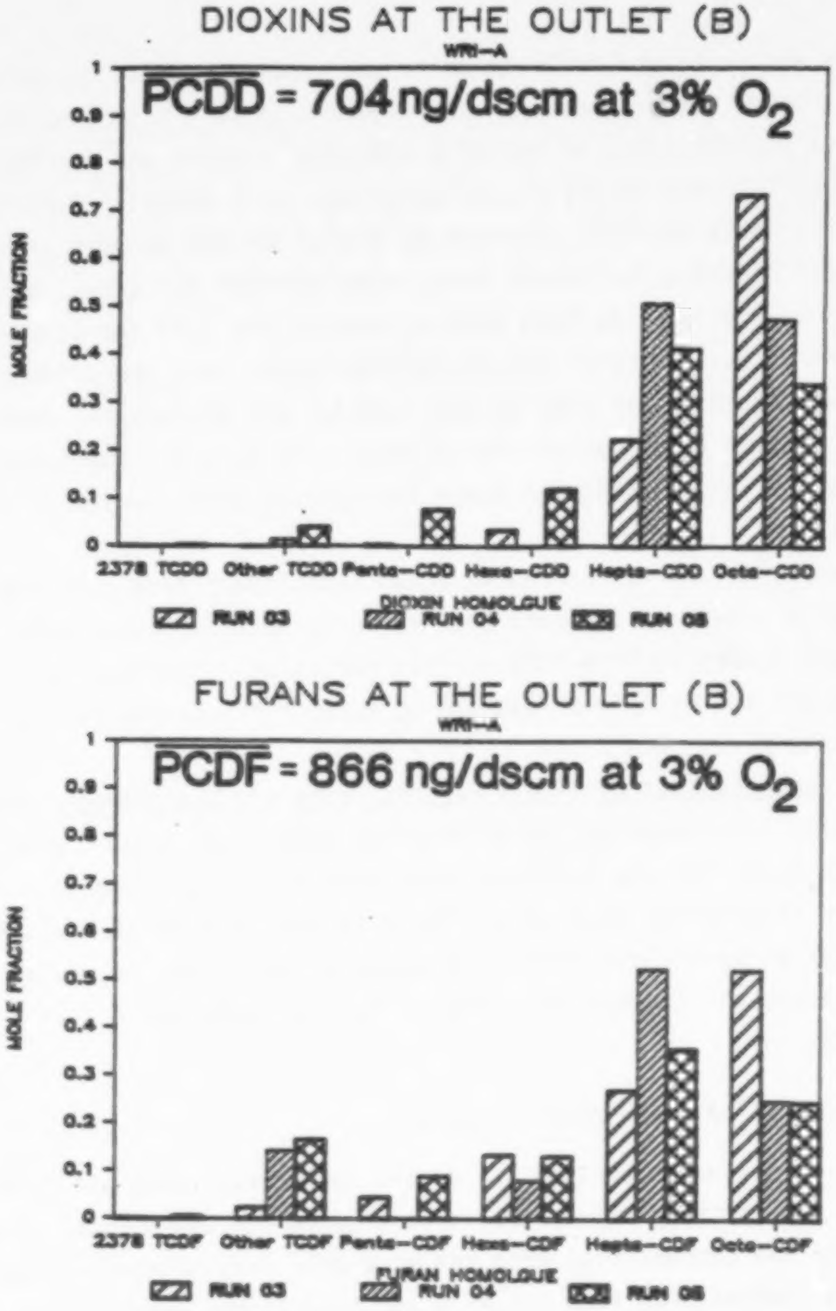


Figure 5-16. Dioxin/furan homologue distribution for the wire and transformer feed runs at Site WRI-A.

TABLE 5-15. DIOXIN/FURAN EMISSION FACTORS FOR SITE WRI-A (WIRE AND TRANSFORMER FEED)

Dioxin/Furan Isomer	Dioxin/Furan Emission Factors (ug/kg)			
	Run 03	Run 04	Run 05	Avg.
DIOXINS				
2378 TCDD	1.16E-04	NR	6.31E-04	3.74E-04
Other TCDD	5.21E-04	3.28E-03	8.36E-03	4.05E-03
Penta-CDD	9.68E-03	NR	1.77E-02	1.37E-02
Hexa-CDD	1.12E-01	NRE+00)	3.01E-02	7.11E-02
Hepta-CDD	7.73E-01	1.53E-01	1.13E-01	3.47E-01
Octa-CDD	2.75E+00	1.55E-01	1.01E-01	1.00E+00
Total PCDD	3.65E+00	3.12E-01	2.71E-01	1.44E+00
FURANS				
2378 TCDF	9.27E-04	NR	4.42E-03	2.67E-03
Other TCDF	5.88E-02	1.34E-01	1.18E-01	1.04E-01
Penta-CDF	1.24E-01	NR	7.07E-02	9.74E-02
Hexa-CDF	4.00E-01	9.38E-02	1.15E-01	2.03E-01
Hepta-CDF	8.76E-01	6.56E-01	3.38E-01	6.23E-01
Octa-CDF	1.83E+00	3.39E-01	2.52E-01	8.07E-01
Total PCDF	3.29E+00	1.22E+00	8.97E-01	1.84E+00

NR - Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.
ND - not detected (detection limit in parentheses).
ug - 1.0E-06g
2080 operating hours per year

NOTE: Emission factors are based on the total feed rate to the incinerator (i.e., metal and combustibles).

TABLE 5-16. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR ALL RUNS AT SITE WRI-A (As-measured concentrations)

Run Number	Feed Description	2378 TCDD	Total PCDD	Total PCDF
Concentration (ng/dscm)				
01	Wire only	NR	51	96
02	Wire only	NR	34	103
06	Wire only	0.093	277	457
Average		0.093	124	225
03	Wire & Transformers	0.051	1610	1450
04	Wire & Transformers	NR	126	493
05	Wire & Transformers	0.115	50	164
Average		0.083	605	715
Emission Rate (ug/hr)				
01	Wire only	NR	0.10	0.20
02	Wire only	NR	0.09	0.26
06	Wire only	0.0003	0.85	1.39
Average		0.0003	0.35	0.62
03	Wire & Transformers	0.0001	3.65	3.29
04	Wire & Transformers	NR	0.31	1.22
05	Wire & Transformers	0.0006	0.27	0.90
Average		0.0004	1.41	1.80

NR = Not reported by Troika. 2378 isomers, if present, were minor components of total amounts of TCDD's/TCDF's.

Table 5-17 summarizes the results of the compound-specific precursor analyses. Significant analytical difficulties were encountered when performing the analyses. These difficulties are discussed in Section 8.3.2. A small amount of chlorinated phenols were detected in both samples, but overall the specific precursors analyzed for (chlorobenzenes, chlorophenols, and chlorinated biphenyls) were not detected. This suggests that either (1) the specific precursors analyzed for were not present in the samples, or (2) the precursors were not easily detected using the GC/MS procedure. Due to the nature of the transformer samples, it was originally anticipated that PCB's would be detected. A total organic halogen (TOX) screen of the samples using a Hall detector indicated the presence of 201 ug/g TOX in the wire insulation sample and 23 ug/g TOX in the transformer combustible samples.

Table 5-18 presents the results of incinerator feed total chloride analysis of transformer combustible samples. The chloride concentration was not very consistent among the samples analyzed. The average total chloride content of the samples was 270 ug/g, with a range of 125 to 443 ug/g.

5.7 ASH SAMPLE ANALYSES

Tables 5-19 and 5-20 summarize the dioxin/furan analyses performed on primary chamber ash and settling chamber ash samples, respectively. Total PCDD content of primary chamber ash samples ranged from 0.2 ppb (Run 05, wire and transformer feed) to 368.2 ppb (Run 01, wire feed only). Total PCDF content of primary chamber ash samples were consistently higher than the PCDD content for all six runs. Total PCDF concentrations ranged from 3.0 ppb (Run 05, wire and transformer feed) to 1335.6 ppb (Run 06 wire only feed).

Settling chamber ash samples consistently contained higher levels of dioxin/furan than the corresponding primary chamber ash samples. Total PCDD concentrations for the settling chamber ash samples ranged from 133.0 ppb (Run 05, wire and transformer feed) to 2217.9 ppb (Run 06, wire feed only). Corresponding total PCDF concentrations ranged from 681.9 ppb (Run 03, wire and transformer feed) to 8332.4 ppb (Run 06, wire only feed.) Overall, for both the primary chamber ash and the settling chamber ash, samples from the wire-only runs contained higher levels of dioxin/furan than samples from the wire and transformers feed runs.

TABLE 5-17. SUMMARY OF DIOXIN PRECURSOR DATA FOR SITE WRI-A FEED SAMPLES

Precursor Categories	Precursor Concentration, ug/g (ppm)	
	Wire Insulation	Wire and Transformer[a]
Total Chlorinated Benzenes	ND	ND
Total Chlorinated Biphenyls	ND	ND
Total Chlorinated Phenols	trace	0.2
Total Halogenated Organics (TOX)	201	20.9, 24.1

[a] Analytical surrogates for the base-neutrals portion of the wire and transformer sample were not detected. See Section 8.3.2.

ND = not detected.

TABLE 5-18. TOTAL CHLORIDE ANALYSES OF THE INCINERATOR FEED SAMPLES FOR SITE WRI-A

Feed Description	Run No.	Total Chloride Concentration (ug/g)
Wire only	01	NA
Wire & Transformers	03	443
	04	125
	05	240
	Average	269

NA = not analyzed.

TABLE 5-19. SUMMARY OF PRIMARY CHAMBER ASH SAMPLE DIOXIN/FURAN ANALYSES FOR SITE WRI-A

Dioxin/Furan Homologue	Homologue Concentration in Primary Chamber Ash Sample (ppb)					
	Run 01[a]	Run 02[a]	Run 03[b]	Run 04[b]	Run 05[b]	Run 06[a]
Dioxins						
2378-TCDD	0.3	0.09	0.02	4.9	ND (0.1)	0.2
Other TCDD	7.8	5.81	2.38	0.2	ND (0.2)	11.0
Penta-CDD	19.9	12.5	4.0	0.3	ND (0.2)	25.9
Hexa-CDD	74.0	33.7	8.4	1.2	ND (0.5)	77.0
Hepta-CDD	155.3	40.0	12.3	1.6	ND (1.0)	108.0
Octa-CDD	110.9	25.2	7.3	1.5	0.2	130.4
Total PCDD	368.2	117.3	34.4	9.7	0.2	352.5
Furans						
2378-TCDF	9.8	5.9	0.6	0.2	ND (0.2)	15.8
Other TCDF	71.9	97.6	13.9	0.1	ND (0.4)	152.2
Penta-CDF	135.3	97.7	18.4	8.0	ND (1.4)	238.4
Hexa-CDF	246.8	139.5	25.9	15.1	1.0	315.5
Hepta-CDF	311.0	126.0	30.1	20.9	1.4	373.2
Octa-CDF	207.4	36.2	7.4	4.1	0.6	240.5
Total PCDF	982.2	502.9	96.3	48.4	3.0	1335.6

[a] Wire only feed

[b] Wire and transformer feed

ND = Not detected at specified minimum limits of detection

TABLE 5-20. SUMMARY OF SETTLING CHAMBER ASH SAMPLE DIOXIN/FURAN ANALYSES FOR SITE WRI-A

Dioxin/Furan Homologue	Homologue Concentration in Settling Chamber Ash Sample (ppb)					
	Run 01[a]	Run 02[a]	Run 03[b]	Run 04[b]	Run 05[b]	Run 06[a]
Dioxins						
2378-TCDD	0.6	0.2	0.06	0.3	0.5	2.3
Other TCDD	3.8	0.6	0.54	3.8	2.4	6.7
Penta-CDD	18.7	13.6	4.1	13.6	3.3	25.7
Hexa-CDD	151.6	79.8	34.0	58.6	19.8	303.0
Hepta-CDD	360.3	199.0	97.9	65.5	40.4	875.3
Octa-CDD	507.2	235.1	99.0	52.4	66.6	1004.9
Total PCDD	1042.2	528.3	235.6	194.2	133.0	2217.9
Furans						
2378-TCDF	44.6	22.4	1.8	6.7	10.5	76.9
Other TCDF	75.4	60.8	30.8	93.3	56.4	209.4
Penta-CDF	401.9	282.5	77.1	193.3	96.9	774.8
Hexa-CDF	1256.4	765.3	197.5	282.7	217.4	1810.8
Hepta-CDF	1895.1	836.9	216.8	274.1	187.0	2844.4
Octa-CDF	2309.2	652.6	157.9	224.6	323.9	2616.1
Total PCDF	5982.6	2620.5	681.9	1074.7	891.8	8332.4

[a] Wire only feed

[b] Wire and transformer feed

5.8 HCl TRAIN CHLORIDE EMISSIONS DATA

Table 5-21 summarizes HCl train chloride emissions data measured at the afterburner outlet sampling location. The data are reported as "front-half," "back-half," and "train-total" chloride emissions. The front-half emissions represent chlorides captured in the probe rinse/filter fraction of the HCl train, which may include metal chlorides contained in the particulate matter. The back-half emissions represent chlorides captured in the HCl sample train impingers, which would include HCl and any metal chlorides that pass through the sample train filter. The train total emissions represent the sum of the front-half and back-half emissions.

As shown in Table 5-21, the average as-measured train-total chloride emissions concentration was approximately 1120 mg/dscm (0.48 grains/dscf) for the wire-only feed runs while the wire and transformer feed runs averaged 440 mg/dscm (0.19 grains/dscf). Corrected to 3% O_2 using the Radian CEM data, this corresponds to approximately 1190 mg/dscm (0.52 grains/dscf) and 530 mg/dscm (.23 grains/dscf), respectively. The average train-total chloride mass emission rate for Runs 01, 02, and 06 (wire feed only) was about 1.0 kg/hr (2.2 lb/hr), while an average of 0.39 kg/hr (0.86 lb/hr) was emitted during Runs 03, 04, and 05 (wire and transformer feed).

TABLE 5-21. HCl TRAIN CHLORIDE EMISSIONS DATA FOR SITE WRI-A

	Wire Feed Only				Wire & Transformer Feed			
Parameter	Run 01[a]	Run 02	Run 06	Average	Run 03	Run 04	Run 05	Average
Total Chloride Concentration (mg/dscf, as-measured)								
Front Half	240, 767	306	189	375	254	96.3	61.7	131
Back Half	586, 265	1955	156	741	743	71.1	88.6	301
Train Total	826, 1032	2261	345	1120	997	167	150	438
Total Chloride Concentration (mg/dscf, corrected to 3% O_2)								
Front Half	260, 832	318	281	423	289	122	104	172
Back Half	636, 288	233	798	847	90.3	150	150	362
Train Total	896, 1120	2353	514	1191	1136	213	254	534
Total Chloride Mass Emission Rate (kg/hr)								
Front Half	0.262, 0.829	0.272	0.164	0.382	0.217	0.094	0.064	0.125
Back Half	0.640, 0.287	1.738	0.135	0.700	0.638	0.064	0.092	0.265
Train Total	0.902, 1.116	2.010	0.299	1.082	0.855	0.163	0.156	0.391

---

[a] The HCl test was conducted twice during this run due to a suspected malfunction in the first HCl train. Sets of data appear reasonable and are recorded in the table.

[b] Concentration corrected to 3% O_2 using the equation:

$[CL^-]$ @ 3% O_2 = $[Cl^-]$, as measured × (20.9 - 3)/(20.9 - %O_2)

where: % O_2 = oxygen concentration in stack gas as measured by Radian CEM System (see Table 5-5).

6.0 SAMPLING LOCATIONS AND PROCEDURES

Samples were collected from six different locations at Site 06. Two of the locations were for gaseous sampling, and four were for solids sampling. The source sampling and analysis matrix in Table 4-1 lists the sample locations, measured parameters, sampling methods, and analytical methods that were used.

Details on the sampling locations and methods are discussed in Sections 6.1 through 6.3 Continuous monitoring procedures for CO, CO_2, O_2, NO_x, and THC are included in Section 6.1.

6.1 GASEOUS SAMPLING

Four types of gaseous samples were taken during this test program: Modified Method 5 (MM5), HCl, EPA Method 3, and continuous monitoring (CEM). The sampling locations and methods are further discussed in this section.

6.1.1. Gaseous Sampling Locations

6.1.1.1 Afterburner Outlet Exhaust Stack. The afterburner outlet exhaust stack sampling locations are shown collectively as point A in Figure 4-1. These locations were used for dioxin sampling and HCl sampling using MM5 procedures described in Section 6.1.2, and also for CEM sampling. Gas velocity, molecular weight, and moisture were determined using EPA Methods 1 through 4.

Dimensions of the afterburner outlet exhaust stack sampling locations are shown in Figure 6-1 along with the temperature monitoring locations. The stack consists of three 4 ft tall refractory lined 24 inch OD steel sections and one 6 ft tall unlined 24 inch OD steel section. The refractory lining is 3 inches thick and the steel is 1/4 inch thick.

Two 4 inch diameter sampling ports were installed approximately 0.5 duct diameters below the top of the stack and 3 duct diameters downstream of the nearest flow disturbance (end of the refractory lined section of the stack). These ports were used for dioxin sampling using the MM5 procedure described in Section 6.1.2.1. Based on EPA Method 1, 24 traverse points were required for velocity determination at this location.

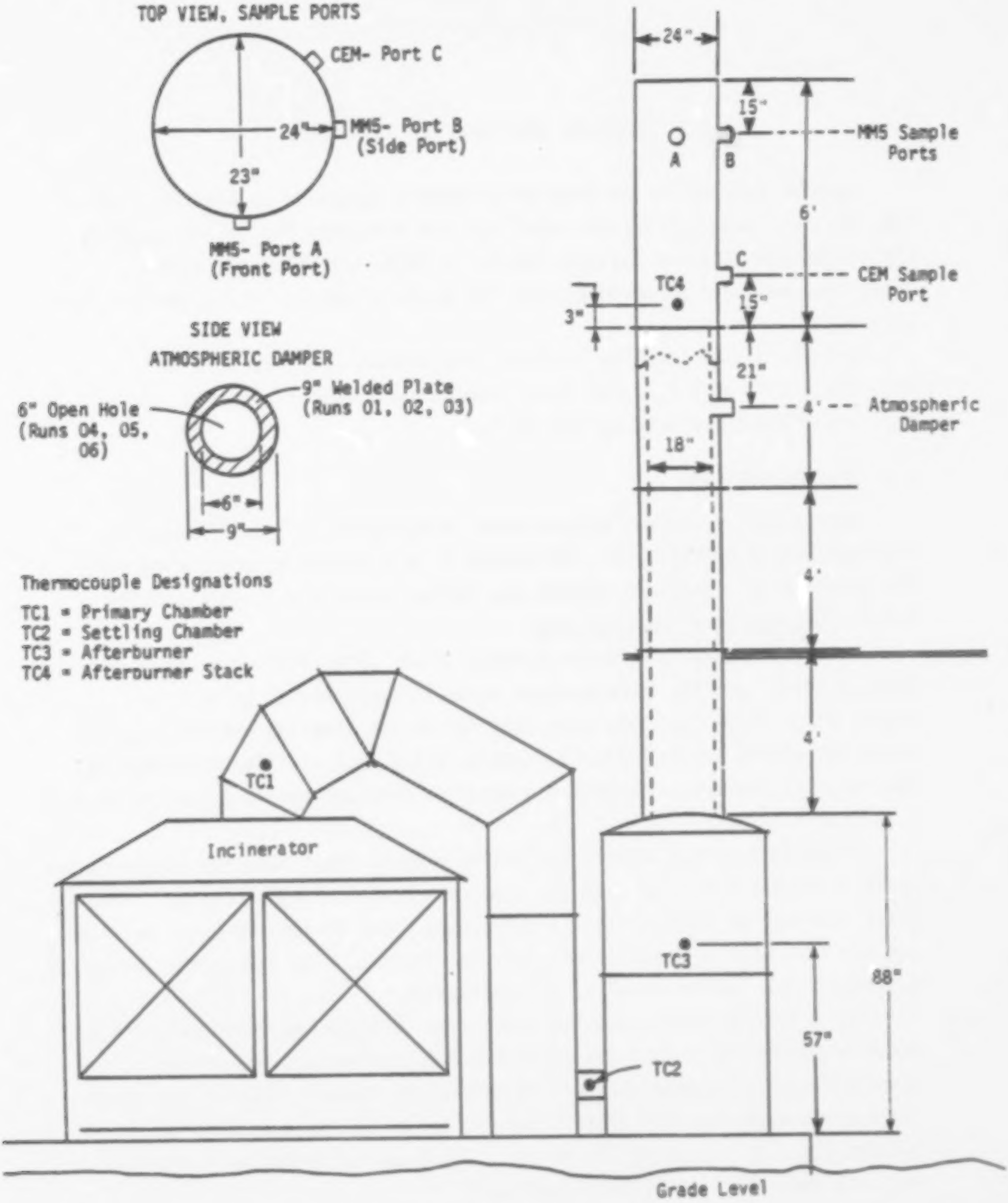

TOP VIEW, SAMPLE PORTS
CEM- Port C
24"
MM5- Port B (Side Port)
23"
MM5- Port A (Front Port)
SIDE VIEW
ATMOSPHERIC DAMPER
6" Open Hole (Runs 04, 05, 06)
9" Welded Plate (Runs 01, 02, 03)
6"
9"
Thermocouple Designations
TC1 = Primary Chamber
TC2 = Settling Chamber
TC3 = Afterburner
TC4 = Afterburner Stack
24"
15"
A
B
MM5 Sample Ports
6'
C
CEM Sample Port
TC4
3"
15"
21"
4'
Atmospheric Damper
18"
4'
4'
TC1
Incinerator
TC3
88"
57"
TC2
Grade Level

Figure 6-1. AFTERBURNER OUTLET SAMPLING LOCATIONS AND TEMPERATURE MONITORING LOCATIONS

One 4 inch diameter sampling port was installed 1.75 duct diameters below the MM5 location. This port was used for continuous monitoring of CO, CO_2, O_2, NO_x, and THC.

The centerline of the atmospheric damper is located approximately 21 inches below the top of the refractory lined section of the stack, which is about 1.5 duct diameters below the CEM sampling port. The damper consists of a 9 inch diameter cylindrical piece of unlined duct that extends approximately 6 inches out from the stack. During Runs 01, 02, and 03, the 9 inch diameter hole at the end of the damper was welded completely shut using a sheet metal plate. A 6 inch diameter hole was re-opened in the plate prior to Run 04 to allow additional combustion air to enter the stack. This returned the unit to its original condition prior to the test program.

6.1.2 Gaseous Sampling Procedures

Gas sampling procedures used during this program are discussed in detail in the Tier 4 Quality Assurance Project Plan (QAPP). A summary of the gas sampling methods used at Site WRI-A is given in Table 6-1, and a brief description of each method is provided in the following sections.

6.1.2.1 Modified Method 5 (MM5). Sampling for dioxin/furan was conducted according to the October 1984 draft of the ASME chlorinated organic compound sampling protocol. This sampling method is a modified version of EPA Method 5 that includes a solid sorbent module for trapping vapor phase organics. The only differences in the sampling protocol which were not discussed in the Tier 4 QAPP are:

(1) Benzene was substituted for hexane or toluene as both the cleanup and extractant solvent for both the MM5 filters and the XAD-2 resin. This was because of a discrepancy between the draft ASME sampling protocol and the draft ASME analytical protocol. (November 16, 1985)

(2) Methylene chloride was substitued for hexane as the final field rinse solvent for the MM5 train. Methylene chloride was also substituted for hexane in the glassware cleaning procedure. This was due to a high field blank train. (February 27, 1985)

TABLE 6-1. SUMMARY OF GAS SAMPLING METHODS FOR SITE WRI-A

Sample Location	Sample Type or Parameter	Sample Collection Method
Afterburner outlet exhaust stack	Dioxin	Modified EPA Method 5
	Volumetric flow	EPA Method 2
	Molecular weight	EPA Method 3
	Moisture	EPA Method 4
	HCl	HCl train
Afterburner Outlet (Point A on Figure 4-1)	CO, CO_2, O_2, NO_x and THC monitoring	Continuous monitors

The MM5 sampling train was used to collect samples at the exhaust stack. A total of six MM5 test runs were conducted, with one test run being conducted per test day. The MM5 samples were collected isokinetically over a minimum 4 hour on-line sampling period at the afterburner outlet in order to provide a minimum sample volume of 90 dscf. Complete batch cycles were sampled to the extent possible, but the variability in batch cycle length and the limited operating hours of the plant made this difficult. A record of the sampling periods in relation to the batch feed history of the incinerator was presented previously in Section 5.1. The MM5 sampling rate ranged from approximately 0.25 dscfm (Run 01) to 0.5 dscfm (Runs 02-06). Following sample recovery, the various parts of the sample (filter, solvent rinses, sorbent trap, etc.) were sent to the EPA's Troika laboratories to quantify the 2378-TCDD, tetra- through octa-dioxin homologues, and tetra- through octa-furan homologues present in the samples.

A schematic diagram of the MM5 sampling train is shown in Figure 6-2. Flue gas is pulled from the stack through a nozzle and a glass probe. Due to the high stack gas temperatures encountered, a water cooled probe was used at this test site. Particulate matter is removed from the gas steam by means of a glass fiber housed in a teflon-sealed glass filter holder maintained at 248 ± 25^{o}F. The gas passes through a sorbent trap similar to that illustrated in Figure 6-3 for removal of organic constituents. The trap consists of separate sections for cooling the gas stream and for adsorbing the organic compounds on Amberlite XAD-2^{R} resin (XAD). A chilled impinger train following the sorbent trap is used to remove water from the flue gas, and a dry gas meter is used to measure the sample gas flow.

6.1.2.2 HCl Determination. HCl concentrations in the outlet exhaust stack was determined using another modification of EPA Method 5. The HCl sample train and operation are identical to those of Method 5 with the following exceptions:

1. Water in the first two impingers was replaced with 0.1 m NaOH.
2. Sampling was single point isokinetic with the nozzle placed at points in the stack with approximate average velocity.
3. The moisture/NaOH in the impingers were saved for laboratory analysis by ion chromatography.

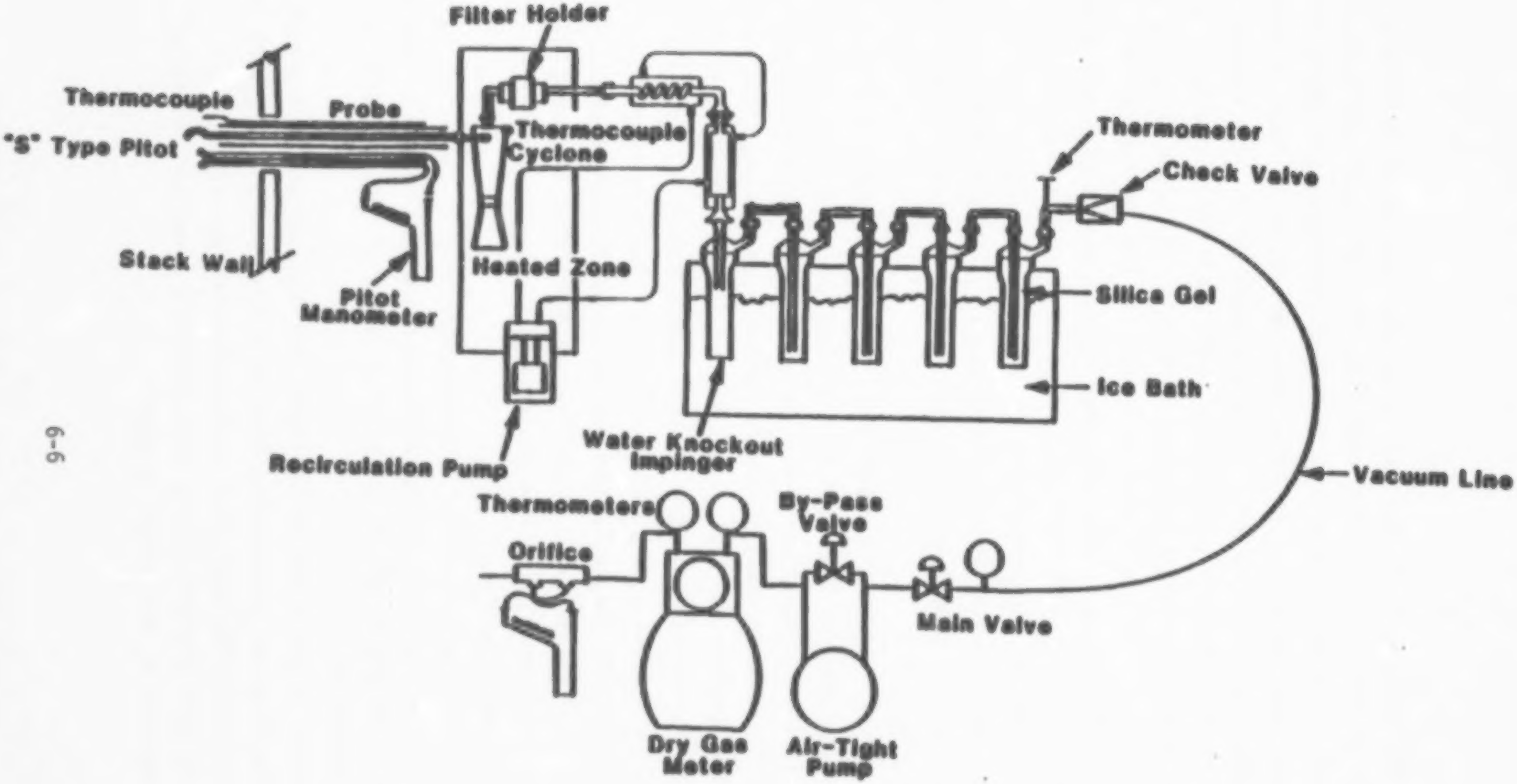

Filter Holder
Thermocouple
Probe
"S" Type Pitot
Thermocouple
Cyclone
Thermometer
Check Valve
Stack Wall
Heated Zone
Pitot
Manometer
Silica Gel
Ice Bath
Water Knockout
Impinger
Recirculation Pump
Vacuum Line
Thermometers
By-Pass
Valve
Orifice
Main Valve
Dry Gas
Meter
Air-Tight
Pump

Figure 6-2. Modified Method 5 train.

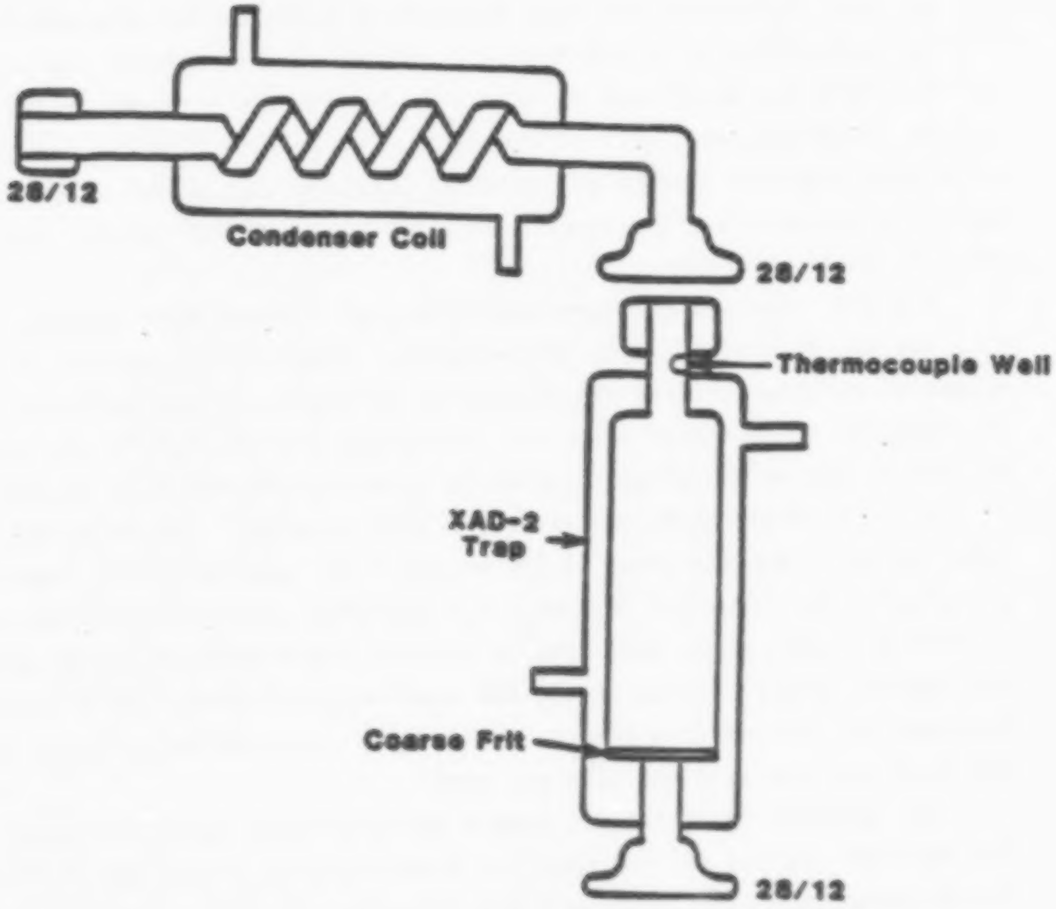

28/12
Condenser Coil
28/12
Thermocouple Well
XAD-2 Trap
Coarse Frit
28/12

Figure 6-3. Adsorbent sampling system.

Recovery of the HCl train provided a sample consisting of three components: probe rinse, filter, and back-half rinse/impinger catch. These samples and appropriate sample blanks were sent to Radian's Austin, Texas laboratory for total chloride analysis via ion chromotagraphy. The filter and probe rinse for each run were combined and analyzed as the "front-half" total chloride, and the impinger catch and rinses were analyzed as the "back-half" total chloride.

6.1.2.3 Volumetric Gas Flow Rate Determination. The volumetric gas flow rate was determined using EPA Method 2. Based on this method, the volumetric gas flow rate was determined by measuring the average velocity of the flue gas and the cross-sectional area of the duct. The average flue gas velocity was calculated from the average gas velocity pressure (ΔP) across an S-type pitot tube, the average flue gas temperature, the wet molecular weight, and the absolute static pressure.

6.1.2.4 Flue Gas Moisture Determination. The moisture content of the flue gas was determined using EPA Method 4. Based on this method, a known volume of particulate-free gas was pulled through a chilled impinger train. The quantity of condensed water was determined gravimetrically and then related to the volume of gas sampled to determine the mositure content.

6.1.2.5 Flue Gas Molecular Weight Determination. The integrated sampling technique described in EPA Method 3 was used to obtain composite flue gas samples for fixed gas (O_2, CO_2, N_2) analysis. A small diaphragm pump and a stainless steel probe were used to extract single point flue gas samples. The samples were collected at the MM5 sampling ports using Tedlar^R bags. Moisture was removed from the gas sample by a water-cooled condenser so that the fixed gas analysis was on a dry basis.

The composition of the gas sample was determined using a Shimadzu Model 3BT analyzer instead of the Fyrite or Orsat analyzer prescribed in Method 3. The Shimadzu instrument employs a gas chromatograph and a thermal conductivity detector to determine the fixed gas composition of the sample.

6.1.2.6 Continuous Monitoring. Continuous monitoring was performed at the afterburner exhaust sampling location for O_2, CO_2, CO, NO_x, and THC throughout the period that dioxin sampling was conducted. The primary intent of the continuous monitoring effort was to observe fluctuations in flue gas parameters and to provide an indication of combustion conditions. Sample acquisition was accomplished using an in-stack filter probe and Teflon^R sample line connected to a mobile laboratory. The heat-traced sample line was maintained at a temperature of at least 120°C (250°F) to prevent condensation in the sample line. The stack gas sample was drawn through the filter and sample line using pumps located in the mobile laboratory. Sample gas to be analyzed for CO, CO_2, O_2, and NO_x were pumped through a sample gas conditioner, which consisted of an ice bath and knockout trap. The sample gas conditioner removes mositure and thus provides a dry gas stream for analysis. A separate unconditioned gas stream was supplied to the THC analyzer for analysis on a wet basis.

An Anarad Model 412 nondispersive infrared (NDIR) analyzer was used to measure CO and CO_2; a Beckman Model 755 paramagnetic analyzer was used to measure O_2; and a Beckman Model 402 flame ionization analyzer was used to measure THC.

6.2 SOLID SAMPLING

Four types of solid samples were collected at Site WRI-A: incinerator feed, primary chamber ash, settling chamber ash, and soils. The sampling locations and methods are discussed in this section.

6.2.1 Incinerator Feed Sampling

Representative feed samples were taken from each feed tray processed in the incinerator during MM5/dioxin sampling. Tray samples taken during each test run were composited at the end of the run. The composite incinerator feed samples for Runs 01, 02, and 06 consisted solely of pieces of wire. The different types of wire on each tray were sampled in visually representative amounts using a manual wirecutter. The composite incinerator feed samples for Runs 03, 04, and 05 consisted of pieces of wire and combustible materials removed from the drained transformer cores. The transformer combustibles consisted primarily of paper, wood, and cardboard pieces that were removed using wire cutters and a saw. Due to the complex construction of the transformer cores, samples that would be representative on a more quantitative basis would be very difficult to obtain.

6.2.2 Incinerator Ash Sampling

Ash samples were obtained from both the primary chamber and the settling chamber after each run. Primary chamber ash was removed from the floor of the primary chamber using a cleaned shovel. Settling chamber ash was raked from the floor of the settling chamber using a flat shovel-like tool. Both ash samples for each run were obtained in the morning following the test run, after the incinerator had cooled down from the previous day's operation. A total of twelve ash samples were submitted to Troika for analysis (2 types of ash samples for each of 6 test runs).

6.2.3 Soil Sampling

A single composite soil sample comprised of 10 individual soil samples was obtained at Site WRI-A. Soil sampling protocol for Tiers 3, 5, 6, and 7 of the National Dioxin Study are specified in the document, "Sampling Guidance Manual for the National Dioxin Study." A similar protocol was used for soil sampling at this test site. A total of 10 soil sampling locations were selected on or near the plant property. The 10 individual soil sampling locations are shown in Figure 6-4. Soil samples were collected by forcing a bulb planter into the soil to a depth of 3 inches. The soil samples were then composited in a clean stainless steel bucket. A portion of the composite was placed in a bottle and returned to Radian/ RTP for archiving.

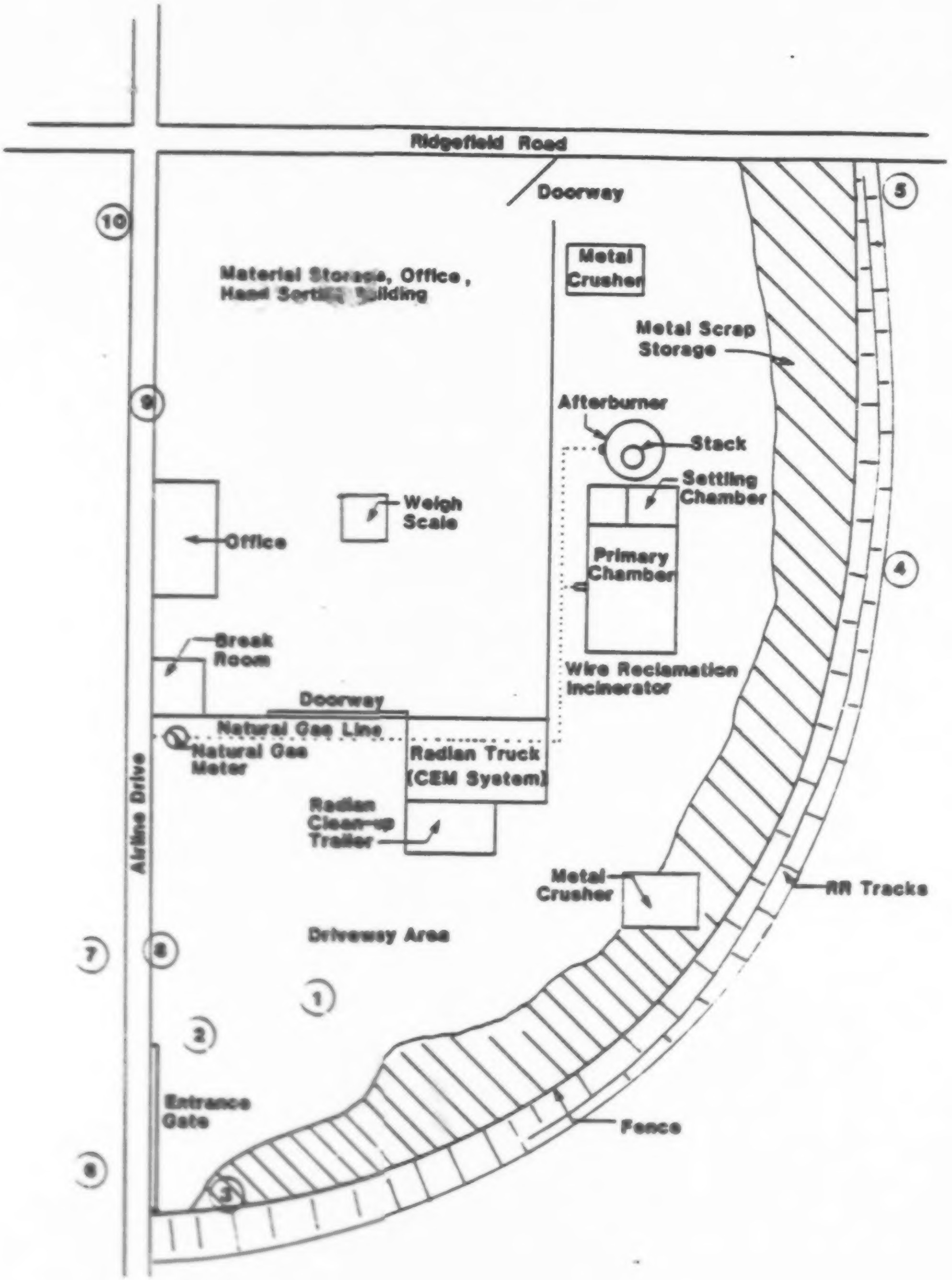

Ridgefield Road
Doorway
5
10
Material Storage, Office,
Hand Sorting Building
Metal Crusher
Metal Scrap Storage
9
Afterburner
Stack
Settling Chamber
Weigh Scale
Office
Primary Chamber
4
Break Room
Wire Reclamation Incinerator
Doorway
Natural Gas Line
Natural Gas Meter
Radian Truck (CEM System)
Airline Drive
Radian Clean-up Trailer
Metal Crusher
RR Tracks
7
8
Driveway Area
1
2
Entrance Gate
Fence
6
3

Figure 6-4. Soil Sampling Locations for Site 06

7.0 ANALYTICAL PROCEDURES

Laboratory procedures used to quantify dioxins/furans and dioxin/furan precursors in the Tier 4 samples are described in this section. MM5 train samples were analyzed by EPA's Troika laboratories for dioxin/furan content. Procedures used for these analyses are described in detail in the Analytical Procedures and QA Plan for the Analysis of Tetra through Octa CDD's and CDF's in Samples from Tier 4 Combustion and Incineration Processes (addendum to EPA/600/3-85-019, April 1985). These procedures are summarized in Section 7.1.

Combustion device feed samples from Site WRI-A were analyzed by Radian to determine concentrations of chlorinated phenols (CP), chlorobenzenes (CB), polychlorinated biphenyls (PCBs), total organic halogen (TOX) and total chlorine. Procedures used for these analyses are detailed in Section 7.2.

7.1 DIOXINS/FURANS

The analytical procedures summarized in this section were used by Troika for dioxin/furan analysis of MM5 train samples from Site WRI-A. Samples consisting of organic solvents, aqueous solutions, and solids were prepared for analysis using slightly different procedures. The organic solvent samples consisted of rinses from the MM5 probe, nozzle, filter housing and condenser coil. Aqueous samples consisted of impinger catch solutions, and solid samples included filters and XAD resin. Isotopically-labeled surrogate compounds were added to all samples prior to extraction to allow determination of method efficiency and for quantification purposes.

Organic liquid samples (e.g., acetone and methylene chloride-based MM5 train rinses) were concentrated using a nitrogen blowdown apparatus. The residue, which contained particulate matter from the MM5 train probe and nozzle, was combined with the filter and handled as a solid sample. Solid samples were extracted with benzene in a Soxhlet apparatus for a period of at least 16 hours. The extract was concentrated by nitrogen blowdown and subjected to chromatographic cleanup procedures.

Aqueous solutions (e.g., MM5 train impinger samples) were extracted with hexane by vigorous shaking for a three hour period. This extraction procedure was repeated three times, with the organic fractions ultimately being combined and concentrated for chromatographic cleanup.

The cleanup procedure involved using chromatographic columns to separate the compounds of interest from other compounds present in the samples. Four different types of columns were used: a combination acid and base modified silica gel column, a basic alumina column, a PX-21 carbon/celite 545 column and a silica/diol micro column. These were used in successive steps, with the last two being used only if necessary.

The cleaned samples were analyzed using high resolution gas chromatography/high resolution mass spectrometry (GC/MS). The conditions for analysis were as follows:

Gas Chromatograph - Injector configured for capillary column, splitless injection, injector temperature 280°C, helium carrier gas at 1.2 ml/min, initial column temperature 100°C, final column temperature 240°C, interface temperature 270°C.

Mass Spectrometer - Varian/MAT Model 311A, electron energy 70ev, filament emission 1mA, mass resolution 8000 to 10,000, ion source temperature 270°C.

7.2 DIOXIN/FURAN PRECURSORS

Feed samples for Site WRI-A were analyzed by Radian/RTP for chlorophenols (CP), chlorobenzenes (CB) and polychlorinated biphenyls (PCBs) by GC/MS, total organic halides (TOX) by GC/Hall detector and total chlorine by Parr bomb combustion followed by ion chromatography. Analytical procedures are discussed in the following sections.

7.2.1 GC/MS Analyses

The analytical procedures used for determining CP, CB, and PCB concentrations in feed samples are modified versions of procedures typically used for the analysis of MM5 train components. These procedures involve initial extraction of the sample with an appropriate solvent, preliminary separation of the compounds of interest by solvent partitioning and liquid chromatography, and analysis of the processed fractions. Solutions containing CB and PCB are injected directly into the GC/MS, and solutions containing CP are derivatized prior to injection. Details on the procedures used for Site WRI-A samples are provided in the sections below.

7.2.1.1 Sample Preparation

A flow chart for the sample preparation procedure used for Site ISW-A feed samples is shown in Figure 7-1. The first step in the procedure involved adding labeled surrogate compounds to provide a measure of extraction method efficiency. The next step involved adding a mixture of 0.5 N NaOH and $MeCl_2$ to the sample and sonicating the sample for 30 minutes. The NaOH and $MeCl_2$ mixture converts the acid compounds to their salts and collects base/neutrals in the organic solvent. The sonicated sample was filtered and rinsed with 0.5 N NaOH. The filtrate was extracted three times in a separatory funnel with $MeCl_2$ and the aqueous and organic fractions were saved for derivatization and/or further cleanup. The aqueous fraction (or acids portion) was acidified to pH 2.0 with HCl and then extracted three times with $MeCl_2$. The $MeCl_2$ from this extraction was dried with anhydrous Na_2SO_4, exchanged to benzene, and concentrated using a nitrogen blowdown apparatus. Acetylation of any CP present in the sample involved the following steps:

1. 2.0 mL isooctane, 2.0 mL acetonitrile, 50 uL pyridine, and 20 uL acetic anhydride were added to the extract. The test tube containing the extract was placed in a 60°C water bath for 15 minutes and was shaken for 30 seconds every 2 minutes.

2. 6.0 mL of 0.01 N H_3PO_4 were added to the test tube, and the sample was agitated for 2 minutes on a wrist action shaker.

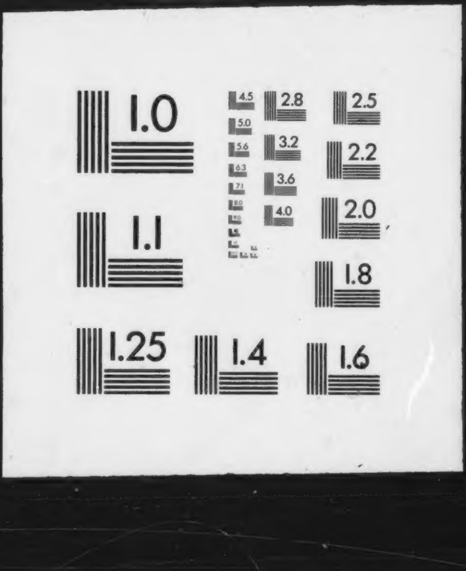
3. The organic layer was removed and the quantitation standard was added. The sample was concentrated in a Reacti-Vial at room temperature (using prepurified N_2) to 1.0 mL prior to GC/MS analysis.

Cleanup of the organic (or base/neutrals) layer from the first $MeCl_2$ extraction involved successively washing the extract with concentrated H_2SO_4 and deionized distilled water. The acid or water was added in a 30 mL portion and the sample was shaken for two minutes. After the aqueous (or acid) and organic layers were completely separated, the aqueous (or acid) layer was discarded. The acid washing procedure was repeated until the acid layer was colorless. The organic fraction from the final wash was dried with anhydrous

2 OF 3

PB 88

101142


1.0
4.5
5.0
5.6
6.3
7.1
8.0
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

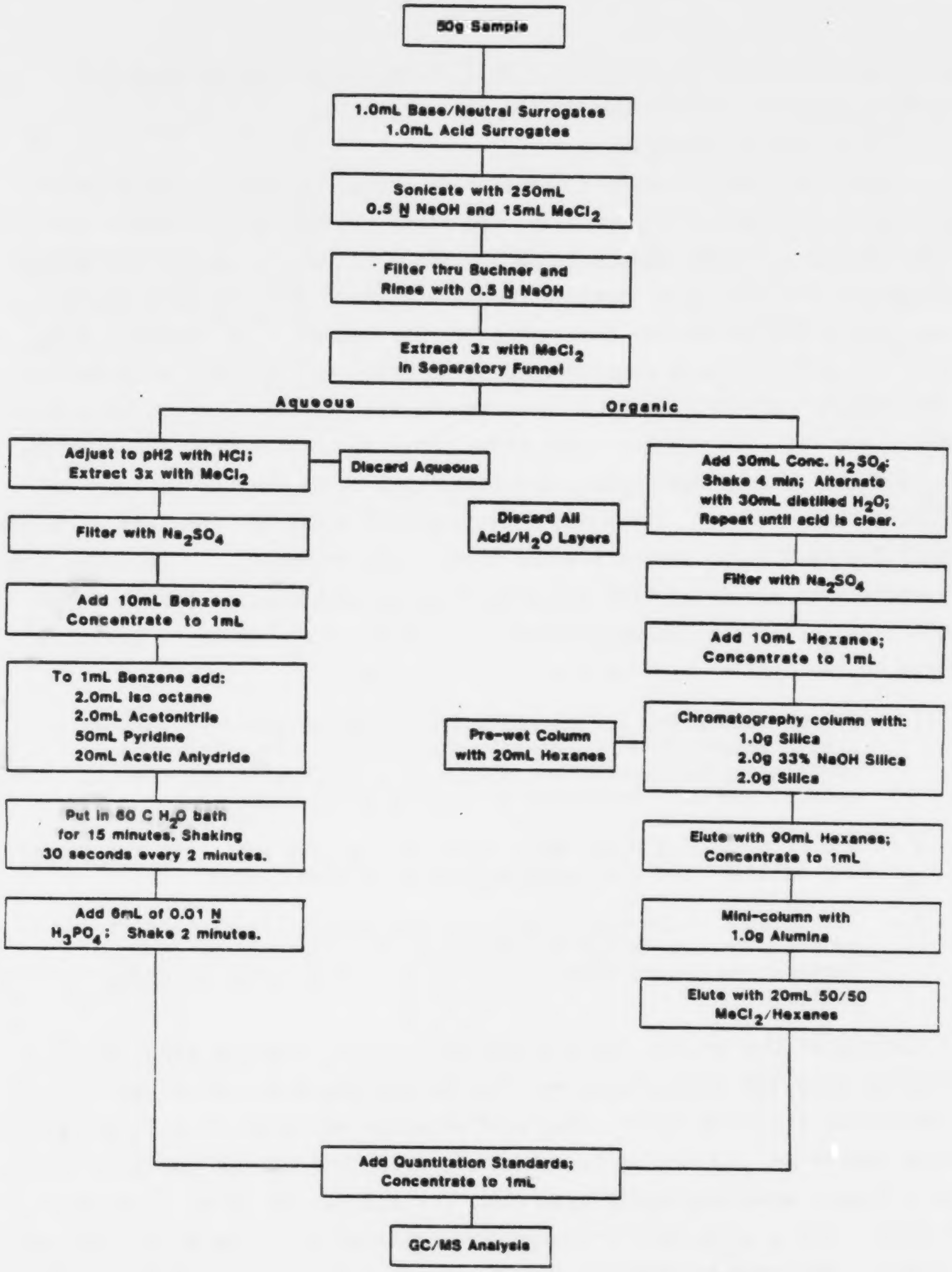

50g Sample
1.0mL Base/Neutral Surrogates
1.0mL Acid Surrogates
Sonicate with 250mL
0.5 N NaOH and 15mL $MeCl_2$
Filter thru Buchner and
Rinse with 0.5 N NaOH
Extract 3x with $MeCl_2$
in Separatory Funnel
Aqueous
Organic
Adjust to pH2 with HCl;
Extract 3x with $MeCl_2$
Discard Aqueous
Add 30mL Conc. H_2SO_4;
Shake 4 min; Alternate
with 30mL distilled H_2O;
Repeat until acid is clear.
Discard All
Acid/H_2O Layers
Filter with Na_2SO_4
Filter with Na_2SO_4
Add 10mL Benzene
Concentrate to 1mL
Add 10mL Hexanes;
Concentrate to 1mL
To 1mL Benzene add:
2.0mL iso octane
2.0mL Acetonitrile
50mL Pyridine
20mL Acetic Anlydride
Pre-wet Column
with 20mL Hexanes
Chromatography column with:
1.0g Silica
2.0g 33% NaOH Silica
2.0g Silica
Put in 60 C H_2O bath
for 15 minutes. Shaking
30 seconds every 2 minutes.
Elute with 90mL Hexanes;
Concentrate to 1mL
Add 6mL of 0.01 N
H_3PO_4; Shake 2 minutes.
Mini-column with
1.0g Alumina
Elute with 20mL 50/50
$MeCl_2$/Hexanes
Add Quantitation Standards;
Concentrate to 1mL
GC/MS Analysis

Figure 7-1. Sample preparation flow diagram for Site WRI-A precursor analysis.

Na_2SO_4, exchanged to hexane and concentrated. Final cleanup of the sample by column chromatography involved the following procedure.

A glass macro-column, 20 mm o.d. x 230 mm in length, tapered to 6 mm o.d. on one end was prepared. The column was packed with a plug of siliconized glass wool, followed successively by 1.0 g silica, 2.0 g silica containing 33% (w/w) 1 N NaOH, and 2.0 g silica. After wetting the chromatography column with hexanes, the concentrated extract was quantitatively transferred to the column and eluted with 90 mL hexanes. The entire eluate was collected and concentrated to a volume of 1 mL in a centrifuge tube.

A disposable liquid chromatography mini-column was constructed by cutting off a 5-mL Pyrex disposable pipette at the 2.0 mL mark and packing the lower portion of the tube with a small plug of silanized glass wool, followed by 1 g of Woehlm basic alumina. The alumina had been previously activated for at least 16 hours at 600°C in a muffle furnace and cooled in a desiccator for 30 minutes just before use. The concentrated eluate from above was quantitatively transferred onto the liquid chromatography column. The centrifuge tube was rinsed consecutively with two 0.3-mL portions of a 3 percent $MeCl_2$: hexanes solution, and the rinses were transferred to the liquid chromatography column.

The liquid chromatography column was eluted with 20 mL of a 50 percent (v/v) $MeCl_2$:hexanes solution, and the eluate was concentrated to a volume of approximately 1 mL by heating the tubes in a water bath while passing a stream of prepurified N_2 over the solutions. The quantitation standard was added and the final volume was adjusted to 1.0 mL prior to GC/MS analysis.

7.2.1.2 Analysis

Analyses for CP, CB and PCBs present in the feed sample extracts were performed with a Finnigan Model 5100 mass spectrometer using selected ion monitoring. A fused silica capillary column was used for chromatographic separation of the compounds of interest. Analytical conditions for the GC/MS analysis are shown in Table 7-1.

Tuning of the GC/MS was performed daily as specified in the Tier 4 QA Project Plan. An internal-standard calibration procedure was used for sample quantitation. Compounds of interest were calibrated against a fixed

Na_2SO_4, exchanged to hexane and concentrated. Final cleanup of the sample by column chromatography involved the following procedure.

A glass macro-column, 20 mm o.d. x 230 mm in length, tapered to 6 mm o.d. on one end was prepared. The column was packed with a plug of siliconized glass wool, followed successively by 1.0 g silica, 2.0 g silica containing 33% (w/w) 1 N NaOH, and 2.0 g silica. After wetting the chromatography column with hexanes, the concentrated extract was quantitatively transferred to the column and eluted with 90 mL hexanes. The entire eluate was collected and concentrated to a volume of 1 mL in a centrifuge tube.

A disposable liquid chromatography mini-column was constructed by cutting off a 5-mL Pyrex disposable pipette at the 2.0 mL mark and packing the lower portion of the tube with a small plug of silanized glass wool, followed by 1 g of Woehlm basic alumina. The alumina had been previously activated for at least 16 hours at 600°C in a muffle furnace and cooled in a desiccator for 30 minutes just before use. The concentrated eluate from above was quantitatively transferred onto the liquid chromatography column. The centrifuge tube was rinsed consecutively with two 0.3-mL portions of a 3 percent $MeCl_2$: hexanes solution, and the rinses were transferred to the liquid chromatography column.

The liquid chromatography column was eluted with 20 mL of a 50 percent (v/v) $MeCl_2$:hexanes solution, and the eluate was concentrated to a volume of approximately 1 mL by heating the tubes in a water bath while passing a stream of prepurified N_2 over the solutions. The quantitation standard was added and the final volume was adjusted to 1.0 mL prior to GC/MS analysis.

7.2.1.2 Analysis

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Tuning of the GC/MS was performed daily as specified in the Tier 4 QA Project Plan. An internal-standard calibration procedure was used for sample quantitation. Compounds of interest were calibrated against a fixed

TABLE 7-1. INSTRUMENT CONDITIONS FOR GC/MS PRECURSOR ANALYSES

Parameter	Chlorobenzenes/ Polychlorinated biphenyls	Chlorophenols
Column	30 m WB DB-5 (1.0 u film thickness) fused silica capillary	
Injector Temperature	290°C	290°C
Separator Oven Temperature	290°C	290°C
Column Head Pressure	9 psi	9 psi
He flow rate	1 mL/min	1 mL/min
GC program	40(4)-290°C, 10°/min & hold	40(1)-290°C, 12°/min & hold
Emission Current	0.50 ma	0.50 ma
Electron Energy	70 ev	70 ev
Injection Mode	Splitless 0.6 min, then 10:1 split	
Mode	Electron ionization, Selected Ion Monitoring	

concentration of either d_{12}-chrysene (for CB, PCB) or d_8-naphthalene (for CP). Components of the calibration solution are shown in Table 7-2. For multi-point calibrations, this solution was injected at concentrations of 10, 50, 100, and 150 ng/ml.

Compound identification was confirmed by comparison of chromatographic retention times and mass spectra of unknowns with retention times and mass spectra of reference compounds. Since the selected ion monitoring technique was necessary for the samples analyzed, care was taken to monitor a sufficiently wide mass region to avoid the potential for reporting false positives.

The instrument detection limit for the analytes of interest (i.e., CP, CB, and PCB) was estimated to be approximately 500 pg on column. For a 50 g sample and 100 percent recovery of the analyte, this corresponds to a feed sample detection limit of 10 ppb.

7.3 TOX ANALYSIS

Incinerator feed samples were analyzed for total organic halide (TOX) by short-column GC and a Hall detector (GC/Hall). Solid samples were extracted with benzene for at least 16 hours in a Soxhlet apparatus. The extracts were washed three times with 100 mL portions of reagent-grade water concentrated to 10 mL.

An attempt to use a fused silica capillary column to separate surrogates from target compounds was unsuccessful due to the complexity of the sample constituents. Determinations for TOX were therefore performed on samples without surrogates and no measure of extraction efficiency is available.

Instrument conditions are shown in Table 7-3. Sample quantitation was based on an average response factor developed from a mixture of chlorinated benzenes and brominated biphenyls. Individual CP, CB, and PCBs were also injected at various concentrations to develop a calibration curve for comparison to the mixture response factors.

TABLE 7-2. COMPONENTS OF THE CALIBRATION SOLUTION

Base/Neutrals	Acids
4-chlorobiphenyl	2,5-dichlorophenol
3,3’-dichlorobiphenyl	2,3-dichlorophenol
2,4’,5-trichlorobiphenyl	2,6-dichlorophenol
3,3’4,4’-tetrachlorobiphenyl	3,5-dichlorophenol
2,2’,6,6’-tetrachlorobiphenyl	3,4-dichlorophenol
2,2,4,5,6-pentachlorobiphenyl	2,3,5-trichlorophenol
2,2’,4,4’,5,5’-hexachlorobiphenyl	2,3,6-trichlorophenol
2,2’,3,4,4’,5’,6-heptachlorobiphenyl	3,4,5-trichlorophenol
2,2’,3,3’,4,4’,5,5’-octachlorobiphenyl	2,4,5-trichlorophenol
2,2’,3,3’,4,4’,5,6,6’-nonachlorobiphenyl	2,3,4-trichlorophenol
decachlorobiphenyl	2,3,5,6-tetrachlorophenol
p-dichlorobenzene	pentachlorophenol
1,2,4-trichlorobenzene	d_6-phenol (SS)
1,2,3,5-tetrachlorobenzene	d_4-2-chlorophenol (SS)
pentachlorobenzene	$^{13}C_6$-pentachlorophenol (SS)
hexachlorobenzene	d_8-naphthalene (QS)
d_4-1,4-dichlorobenzene (SS)[1]	2,4,6-tribromophenol (QS)
3-bromobiphenyl (SS)	d_{10}-phenanthrene (QS)
2,2’,5,5’-tetrabromobiphenyl (SS)	d_{12}chrysene (QS)
2,2’,4,4’,6,6’-hexabromobiphenyl (SS)	
octachloronaphthalene (QS)[2]	
d_{10}-phenanthrene (QS)	
d_{12}-chrysene (QS)	

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[1] Surrogate standard.

[2] Quantitation standard.

TABLE 7-3. ANALYTICAL CONDITIONS FOR TOX ANALYSIS

Hall Detector Conditions

Reactor temperature - 850°C

Solvent - n-propanol

Hydrogen flow rate - 35 mL/min

GC Conditions (Varian 3700)

Injection volume (1 - 5 uL)

Helium carrier gas flow rate - 60 mL/min

Column - 3-ft packed column with 1 in 10% OV 101

Column temperature - 200°C isothermal

8.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This section summarizes the results of the quality assurance and quality control (QA/QC) activities for Site WRI-A. The flue gas dioxin/furan data for this site were generally outside the QC specifications presented in the Tier 4 QAPP. Run 05 sample was the only run having surrogate recoveries within the QC limit of 50 to 120 percent for the tetra-chlorinated homologues and 40 to 120 percent for hepta- and octa-CDD's. The results of the analysis of the fortified laboratory QC sample were all within 50 percent of the true value, which is within the Tier 4 objective of ± 50 percent.

Analytical recovery efficiencies for six isotopically-labeled compounds used as surrogates for the target precursor analytes in the Site WRI-A feed samples varied considerably. Several of the recoveries were below the 50 percent QA objective stated in the Tier 4 QAPP. The base neutrals portion of transformers combustible analyses were unsuccessful.

The following sections summarize the results of Site WRI-A QA/QC activities. Manual gas sampling methods are considered in Section 8.1 and continuous emission monitoring and molecular weight determinations are considered in Section 8.2. The laboratory analysis QA/QC activities are summarized in Section 8.3.

8.1 MANUAL GAS SAMPLING

Manual gas sampling methods at Site WRI-A included Modified Method 5 (MM5), EPA Methods 1 through 4, and HCl testing. These methods are discussed in Section 6.0. Quality assurance and quality control (QA/QC) activities for the manual sampling methods centered around (1) equipment calibration, (2) glassware precleaning, (3) procedural QC checks and (4) sample custody procedures. Key activities and QC results in each of these areas are discussed in this section. Also discussed are problems encountered that may have affected data quality.

8.1.1 Equipment Calibration and Glassware Preparation

Pre-test calibrations or inspections were conducted on pitot tubes, sampling nozzles, temperature sensors and analytical balances. Both pre-test and post-test calibrations were performed on the dry gas meters. All of the field test equipment met the calibration criteria specified in the Tier 4 Quality Assurance Project Plan (QAPP). Differences in the pre-test and post-test dry gas meter calibrations were less than 2 percent (%).

An extensive pre-cleaning procedure was used for all sample train glassware and sample containers. This cleaning procedure, which is outlined in Table 8-1, was implemented to minimize the potential for sample contamination with substances that could interfere with the dioxin/furan analysis. To minimize the potential for contamination in the field, all sample train glassware was capped with foil prior to use. A sample trailer was maintained for the specific purpose of sample train assembly and recovery.

8.1.2 Procedural QC Activities/Manual Gas Sampling

Procedural QC activities during the manual gas sampling for dioxin/furan and HCl focused on:

- visual equipment inspections,
- utilization of sample train blanks,
- ensuring the proper location and number of traverse points,
- conducting pre-test and post-test sample train leak checks,
- maintaining proper temperatures at the filter housing, sorbent trap and impinger train,
- maintaining isokinetic sampling rates, and
- recording all data on preformatted field data sheets.

Unusual circumstances noted while carrying out the procedural QC activities are discussed below.

The first opportunity for a preliminary velocity traverse was on the first test day. The average stack gas velocity was found to be approximately 1.2 meter/min (4 ft/min), which was lower than expected. Using the largest available MM5 nozzle size (0.5 inch), the isokinetic gas sampling rate was approximately 0.007 m^3/min (0.25 cfm). In order to maximize the amount of gas sampled with this low sample flow rate, the testing period for Run 01 was increased from the usual 4-hour length to the maximum possible length under the operating schedule constraints of the plant. In addition, only one port

TABLE 8-1. GLASSWARE PRECLEANING PROCEDURE

NOTE: USE DISPOSABLE GLOVES AND ADEQUATE VENTILATION

1. Soak all glassware in hot soapy water (Alconox^R) 50°C or higher.
2. Distilled/deionized H_2O rinse (X3).[a]
3. Chromerge^R rinse if glass, otherwise skip to 6.
4. High purity liquid chromatography grade H_2O rinse (X3).
5. Acetone rinse (X3), (pesticide grade).
6. Methylene chloride rinse (X3), (pesticide grade).
7. Cap glassware with clean glass plugs or methylene chloride rinsed aluminum foils.

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[a] (X3) = three times.

was traversed for Run 01, which eliminated the hour or more that would have been necessary to change ports with the water cooled probe assembly. The resulting on-line test period for Run 01 was 340 minutes long, and a sample gas volume of 2.5 dscm (89 dscf) was obtained. While this sample gas volume did not achieve the usual Tier 4 target of 120 dscf for an outlet location, it essentially met the Site 06 test plan target of 90 dscf. Following Run 01, larger sample nozzles were obtained (1.7 cm, or 0.7 inch), which allowed for a higher isokinetic sampling rate (approximately 0.014 m^3/min, or 0.5 cfm). Test durations for Runs 02-06 ranged from 240 to 300 minutes, and sample gas collection volumes ranged from 3.2 dscm (114 dscf) to 3.9 dscm (138 dscf). Port changes during Runs 02-06 were carried out as originally planned (i.e., one port change per test run).

The first HCl run also led to sampling changes for successive test runs. During the first HCl run a water cooled probe was used, and condensed moisture was observed running out of the probe and into the filter assembly. A second HCl run was performed on the first test day without water cooling and using a cyclone to collect any condensate prior to the filter. Following these modifications, moisture was still observed to be condensing out in the probe and cyclone, but the situation was improved relative to the first HCl run. One HCl run was performed on each successive test day using the non-water cooled probe and the cyclone, which resulted in a total of seven HCl runs.

During the final MM5 leak check of Run 02, the sample train impinger contents were inadvertently transferred back into the condensate knockout trap. The XAD trap and filter were visually inspected and found to be unaffected. During Run 03, a hole occurred in the MM5 sample train filter. The hole was discovered when black particulate was observed in the condenser coils. A new filter was installed, and the run proceeded. Runs 04, 05, and 06 were completed without any significant unusual occurrences from a sampling perspective.

As discussed earlier, plant personnel reported that the incinerator opacity was higher than normal during Runs 01-03, particularly during Run 03 (the first wire and transformer run). Before starting Run 04 a hole was cut in the atmospheric damper plate that had been installed just prior to Run 01. This hole provided additional combustion air downstream of the afterburner and resulted in a lengthening of the afterburner flame. Flames were observed through the MM5 sample port holes and at times out of the top of the stack. Visual opacity was significantly reduced. As a result, the hole was left open during Runs 04 through 06 and the testing was completed without any known problems.

Results of the average isokinetics calculations for the six MM5 test runs are shown in Table 8-2. The average isokinetics for Runs 01-04 exceeded the quality assurance (QA) objective of 100 ± 10 percent, but Run 01 was the only test for which the exceedance was significant (120.5% isokinetics). The average isokinetics for Runs 05 and 06 were within the QA objective. Based on the magnitude of the isokinetics values and the high stack gas temperatures measured, it is felt that the QA exceedances of isokinetics for Runs 01-04 did not significantly affect the quality of the data.

The two main reasons for the difficulty in achieving the QA isokinetics objective at Site WRI-A were the variability of stack gas flow rate and temperature during the test runs. An inclined manometer graduated in 0.01 inch increments was used to determine the pitot readings, which ranged from 0.01 to 0.02 inches of water. At a typical stack temperature of 1300°F, this corresponds to a 40 percent variation in stack gas velocity. Stack temperatures also showed a high degree of variability, with the maximum within-run deviation being about 220°C (400°F).

A field blank sample train was used at the MM5 sample location to determine the background levels of contaminants that might interfere with dioxin and furan analysis. The glassware in the field blank train had been used in a previous test run at Site WRI-A and cleaned up according to the ASME protocol. The field blank train was transported to and assembled at the sample location. Recovery was performed in the same sequence as for a normal test run. All solvents used in the recovery of blanks came from the same containers as for normal test runs. The field blank sample train components were submitted to Troika for dioxin analysis. A proof train blank consisting of MM5 sample train recovery components from a train that had not been used in a previous test run at Site WRI-A was also submitted to Troika for dioxin analysis.

TABLE 8-2. SUMMARY OF ISOKINETIC RESULTS FOR MM5

MM5 Run[a]	% Isokinetic	Meets QC Objective[a]
01	120.5	No
02	111.3	No
03	110.1	No
04	111.1	No
05	100.2	Yes
06	103.5	Yes

[a] The quality assurance objective for MM5 sampling was isokinetics of 100±10 percent.

Initial, final, and port change leak checks for the MM5 and HCl sample trains achieved the QA objectives for all of the test runs. None of the reported sample volumes required correction for sample train leakage. All leak check data are noted on the MM5 field data sheets.

8.1.3 Sample Custody

Sample custody procedures used during this program emphasized careful documentation of the samples collected and the use of chain-of-custody records for samples transported to the laboratory for analysis. Steps taken to identify and document samples collected included labeling each sample with a unique alphanumeric code and logging the sample in a master logbook. All samples shipped to Troika or returned to Radian/RTP were also logged on chain-of-custody records that were signed by the field sample custodian upon shipment and also signed upon receipt at the laboratory. Each sample container lid was individually sealed to ensure that samples were not tampered with. No evidence of loss of sample integrity was reported for samples collected at this site. However, minor leakages were reported by Troika for a few of the sample bottles.

8.2 CONTINUOUS MONITORING/MOLECULAR WEIGHT DETERMINATION

Flue gas parameters measured continuously at the afterburner outlet location during Runs 01-05 included CO, CO_2, O_2, total hydrocarbons (THC) and NO_x. During Run 06, THC was the only continuously monitored parameter due to a malfunction in the sample gas conditioner. The concentrations of O_2, CO, CO_2, and nitrogen (N_2) were also determined for integrated bag samples of the flue gas. Quality control results for these analyses are discussed in this section.

Drift check results for the continuously monitored flue gas parameters are summarized in Table 8-3. Data reduction was performed by assuming a linear drift of the instrument response over the test day based on drift checks at the beginning and end of the day. The largest calibration drifts were observed for the NO_x analyzer, which exceeded QC target goals of ±10 percent drift for 3 test runs. The smallest instrument drift was observed for the oxygen monitor. A power source disruption occurred on 3/25/85 after the completion of Run 05 but before the completion of the final calibrations

Table 8-3. SUMMARY OF DRIFT CHECK AND CONTROL STANDARD RESULTS

			Drift Check			QC Standard			
Test Date	Test Run	Parameter	Input Concentration	Instrument Drift, %^{a}	Meets QC?^{b}	Input Concentration	Output Concentration	Difference From Running Mean, %	Meets QC?^{c}
3/19/85	01	O_2	21.0% V	0.57	Yes	9.3% V	9.8	--	Yes
3/20/85	02	O_2	21.0% V	-0.53	Yes	9.3% V	9.8	0.00	Yes
3/21/85	03	O_2	21.0% V	0.12	Yes	9.3% V	9.9	0.71	Yes
3/22/85	04	O_2	21.0% V	-0.16	Yes	9.3% V	9.8	-0.25	Yes
3/25/85	05	O_2	21.0% V	--^{d}	--^{d}	9.3% V	9.8	-0.20	Yes
3/26/85	06	O_2	21.0% V	--^{e}	--^{e}	--^{e}	--^{e}	--^{e}	--^{e}
3/19/85	01	CO	5170 ppmv	2.9	Yes	2006.0 ppmv	2219.9	--	Yes
3/20/85	02	CO	5170 ppmv	6.6	Yes	2006.0 ppmv	2239.1	0.43	Yes
3/21/85	03	CO	5170 ppmv	5.7	Yes	2006.0 ppmv	2201.0	-0.86	Yes
3/22/85	04	CO	5170 ppmv	4.0	Yes	2006.0 ppmv	2218.9	-0.03	Yes
3/25/85	05	CO	5170 ppmv	--^{d}	--^{d}	2006.0 ppmv	2219.2	-0.02	Yes
3/26/85	06	CO	5170 ppmv	--^{e}	--^{e}	2006.0 ppmv	2256.0	1.39	Yes
3/19/85	01	CO_2	18.5% V	7.1	Yes	13.0% V	12.7	--	Yes
3/20/85	02	CO_2	18.5% V	7.5	Yes	13.0% V	13.5	3.15	Yes
3/21/85	03	CO_2	18.5% V	20.3	No	13.0% V	12.9	-0.99	Yes
3/22/85	04	CO_2	18.5% V	14.4	No	13.0% V	12.6	-2.48	Yes
3/25/85	05	CO_2	18.5% V	--^{d}	--^{d}	13.0% V	13.2	1.69	Yes
3/26/85	06	CO_2	18.5% V	--^{e}	--^{e}	13.0% V	13.02	0.23	Yes

(continued)

Table 8-3. Concluded

			Drift Check			QC Standard			
Test Date	Test Run	Parameter	Input Concentration	Instrument Drift, %[a]	Meets QC?[b]	Input Concentration	Output Concentration	Difference From Running Mean, %	Meets QC?[c]
3/19/85	01	NO_x	289 ppmv	1.9	Yes	157.0 ppmv	151.6	--	Yes
3/20/85	02	NO_x	289 ppmv	-15.09	No	157.0 ppmv	160.6	2.9	Yes
3/21/85	03	NO_x	289 ppmv	20.18	No	157.0 ppmv	157.6	0.64	Yes
3/22/85	04	NO_x	289 ppmv	29.5	No	157.0 ppmv	149.4	-3.49	Yes
3/25/85	05	NO_x	289 ppmv	--[d]	--[d]	157.0 ppmv	162.7	4.09	Yes
3/26/85	06	NO_x	289 ppmv	--[e]	--[e]	--[e]	--[e]	--[e]	--[e]
3/19/85	01	THC	444 ppmv	--[f]	--[f]	90.0 ppmv	90.64	--	Yes
3/20/85	02	THC	444 ppmv	4.8	Yes	90.0 ppmv	96.70	3.34	Yes
3/21/85	03	THC	444 ppmv	16.5	No	90.0 ppmv	94.20	0.37	Yes
3/22/85	04	THC	444 ppmv	1.8	Yes	90.0 ppmv	98.00	3.29	Yes
3/25/85	05	THC	444 ppmv	2.0	Yes	90.0 ppmv	91.72	-2.68	Yes
3/26/85	06	THC	444 ppmv	4.5	Yes	90.0 ppmv	94.51	0.23	Yes

[a] Instrument drift is defined as the percent difference between the instrument drift response to the input concentration at the beginning and end of the test run.

[b] QC criteria was instrument drift within +/- 10 percent.

[c] QC criteria was output concentration within +/- 10 percent of the running mean concentration for this test site.

[d] Not available due to power disruption at end of Run 05.

[e] No data available for Run 06 due to gas conditioner malfunction.

[f] No THC drift check data available for Run 01 due to blocked capillary.

for that day. THC was the only gas for which final calibrations had been completed. As a result, drift check data for O_2, CO, CO_2, and NO_x are not available for Run 05.

The quality control gases for this program consisted of mid-range concentration standards different than those used for instrument calibration. The QC gases were analyzed immediately after calibration each day to provide data on day-to-day instrument variability. The acceptance criteria for the analysis of each QC standard was agreement within ± 10 percent of the running mean value. This criteria was met for each of the monitored gases on each test day for which continuous monitoring was performed.

Continuous monitoring data for O_2, CO, CO_2, and NO_x were not obtained during Run 06 because the sample gas conditioner had become blocked with hydrocarbon residue deposited during Runs 01-05. As discussed in Section 6.1.2.6, these instruments require a dry gas stream for analysis. Continuous monitoring data for THC were still collected during Run 06 because this instrument operates with a wet gas stream with no need for the gas conditioner. Integrated bag samples analyzed using the Shimadzu gas chromatograph were used to develop mean concentration data for O_2, CO, and CO_2 during Run 06. The bag samples were taken during consecutive 30 minute intervals. Quality control for the bag sample analysis involved duplicate analyses of calibration gases immediately before and after sample analysis. Analysis of the calibration gases was repeated until two consecutive analyses within ± 5 percent were obtained. This same criteria of ± 5 percent applied to duplicate analyses required for sample quantification. These criteria were met for all molecular weight determinations. The continuously monitored THC data were then averaged over the time period that coincided with the bag samples (30 minute periods) to provide mean THC concentration values at the coincidental O_2, CO and CO_2 data points.

For Runs 01-05 the flue gas molecular weight was calculated using the average O_2 and CO_2 values as determined by the continuous monitors. The continuous monitoring data were used instead of the integrated bag sample data generated using the gas chromatograph because the CEM data were considered more reliable for this test site. For Run 06 the flue gas molecular weight was calculated using the bag sample data because there were no CEM data available for that run.

8.3 LABORATORY ANALYSES

QA/QC activities were carried out for dioxin/furan, precursor, and total chloride analyses performed on Site WRI-A samples. The dioxin/furan analyses of MM5 train samples performed by Troika are considered in Section 8.3.1; the precursor analyses of wire recovery incinerator feed samples performed by Radian/RTP are considered in Section 8.3.2; and the total chloride analyses of HCl train samples performed by Radian/Austin are considered in Section 8.3.3.

8.3.1 Dioxin/Furan Analyses

Two individual topics related to the dioxin/furan analyses at Site WRI-A are discussed in this section. Analytical recoveries of labeled surrogate compounds spiked onto MM5 train samples are reported in Section 8.3.1.1. Sample blank data are reported in Section 8.3.1.2.

8.3.1.1 Surrogate Recoveries of Test Samples

Table 8-4 presents the analytical recovery data reported by Troika for four isotopically labeled surrogate compounds spiked onto the MM5 train samples. Samples from Runs 03 and 06, which were the first MM5 samples analyzed, were analyzed in three separate parts. Part A was the liquid portion from the MM5 sample train, while part B was particulate recovered from the liquid portion. Part C was the XAD-2 and particulate filter sample. In general, surrogate recoveries for MM5 samples from Site WRI-A were outside the Tier 4 target ranges of 50-120 percent for the tetra-chlorinated homologues and 40-120 percent for the hepta- and octa-chlorinated homologues. Run 05 (wire and transformer feed) was the only test run for which analytical recoveries for all surrogates were within the Tier 4 target ranges.

Surrogate recoveries could not be determined or were outside of the Tier 4 quality assurance ranges for the MM5 samples because of the relatively large quantities of native CDD and CDF species present in the samples. Since no measure of extraction method efficiency is available for all of the MM5 samples, it should be noted that the reported analytical results for native compounds may actually represent lower bounds on the true values.

8.3.1.2 Sample Blanks

Table 8-5 summarizes the analytical results reported by Troika for internal laboratory blanks, laboratory fortified quality control (QC) samples,

TABLE 8-4. PERCENT SURROGATE RECOVERIES FOR SITE WRI-A DIOXIN/FURAN ANALYSES

Sample	$^{37}Cl_4$ TCDD	$^{13}C_{12}$ TCDD	$^{37}Cl_4$ Hepta-CDD	$^{13}C_{12}$ Octa-CDD
MM5 Train Samples				
Wire Feed Only				
Run 01	13	80	0	18
Run 02	10	36	0	11
Run 06A	0	NS	0.2	NS
06B	NS	66	NS	81
06C	NR	NR	NR	NR
Wire and Transformer Feed				
Run 03A	0	NS	0	NS
Run 03B	NS	76	NS	115
Run 03C	NS	54	NS	10
Run 04	5	76	20	4
Run 05	92	96	53	61

NR = Not reported by Troika

NOTE: Runs 03 and 06 were analyzed in three different parts. They are segregated as follows:

A - Liquid portion
B - Particulate from liquid portion
C - XAD-2 and filter

NS = Surrogate species was not spiked onto this portion of the MM5 train.

TABLE 8-5. ANALYSIS RESULTS FOR QUALITY CONTROL SAMPLES

	Flue Gas Quality Control Samples						
	Runs 03 and 06			Runs 01, 02, 04, and 05			
		Fortified Laboratory QC Sample			Fortified Laboratory QC Sample		
	Laboratory Blank	Measured Value	True Value[a,b]	Laboratory Blank	Measured Value	True Value[a,b]	Field Blank MM5 Train
	Amount Detected (Nanograms/sample)						
Dioxins							
2378 TCDD	ND	0.2	0.4 (-50)	ND	0.3	0.4 (-25)	ND
Other TCDD	ND	ND	ND (0)	ND	ND	ND (0)	0.2
Penta CDD	ND	ND	ND (0)	ND	ND	ND (0)	ND
Hexa CDD	ND	0.7	1.6 (-56)	ND	0.8	1.6 (-50)	ND
Hepta CDD	ND	1.4	2.4 (-42)	ND	2.2	2.4 (-8)	0.2
Octa CDD	ND	1.8	3.2 (-39)	0.05	2.8	3.2 (-13)	0.5
Furans							
2378 TCDF	ND	0.2	0.4 (-50)	ND	0.4	0.4 (0)	ND
Other TCDF	ND	ND	ND (0)	ND	ND	ND (0)	0.2
Penta CDF	ND	0.4	0.8 (-50)	ND	0.5	0.8 (-38)	0.2
Hexa CDF	ND	0.8	1.6 (-50)	ND	0.8	1.6 (-50)	0.4
Hepta CDF	ND	1.3	2.4 (-46)	ND	2.2	2.4 (-8)	0.5
Octa CDF	ND	1.7	3.2 (-49)	ND	2.8	3.2 (-13)	0.4
	Surrogate Recoveries (Percent)						
$^{37}Cl_4$ TCDD	NR	NR	NA	78	84	NA	101
$^{13}C_{12}$ TCDD	86	94	NA	106	88	NA	94
$^{37}Cl_4$ Hepta-CDD	NR	NR	NA	62	45	NA	88
$^{13}C_{12}$ Octa-CDD	71	49	NA	46	47	NA	70

[a] True values represent the amounts of each homologue spiked into the laboratory fortified QC samples.

[b] Value shown in parenthesis is the percentage difference between the measured and the true value:

$$\% = \frac{\text{Measured Value - True Value}}{\text{True Value}} \times 100$$

NR = Not reported by Troika.

ND = Not detected.

NA = Not applicable.

TCDD = Tetra-chlorinated dibenzo-p-dioxin.

TCDF = Tetra-chlorinated dibenzofuran.

and field recovery blank MM5 train samples. Samples from all test runs were not analyzed at the same time. Therefore there were different internal laboratory blank and laboratory fortified QC samples for Runs 03 and 06 than for Runs 01, 02, 03 and 04. In general, the surrogate recoveries for the blank samples were within acceptable limits with values ranging from 46 to 106 percent. Comparison of the measured and spiked values for the laboratory fortified QC samples showed agreement to within ± 50 percent for all target species except the hexa-CDD isomer. The measured value for the hexa-CDD isomer was approximately 56 percent lower than the spiked value.

Small but detectable quantities of several dioxin and furan species were found in the field blank MM5 train. Table 8-6 gives a comparison of the dioxin/furan analytical results for the field blank MM5 train and the test run MM5 trains. The only species which showed any sign of a blanking problem was "other TCDD" where the blank was 22 percent of the minimum test run value. Most field blank values were less than one percent of the minimum test run value. Overall, the field clean-up procedures were found to be adequate for this test site. Emissions data reported in Section 5.4 are not blank-corrected.

8.3.2 Precursor Analyses

Table 8-7 presents analytical recovery efficiencies for six isotopically labeled compounds used as surrogates for the target precursor analytes in the Site WRI-A feed samples. Several of the recoveries are below the 50 percent objective stated in the Tier 4 QA Project Plan and are below those generally considered achievable when analyzing for similar compounds in water or in MM5 train components. Recoveries of d_4-dichlorobenzene, bromobiphenyl, and 2', 5, 5'tetra bromobiphenyl for the transformer combustible samples were negligible. This indicates that the base-neutrals portion of the transformer combustibles analyses was unsuccessful. Thus, it can be concluded that neither chlorobenzenes or PCB's were successfully analyzed for in these samples.

8.3.3 Total Chloride Analysis

Total chloride analyses were performed by Radian/Austin on the HCl train samples. QA/QC activities include total chloride analysis of field recovery blank HCl train samples and total chloride analysis of an aliquot of the NaOH solution used in the sample train impingers. Chlorides were detected in the field recovery blank sample trains. The front-half of the train contained

TABLE 8-6. FIELD BLANK DIOXIN/FURAN DATA FOR SITE WRI-A MM5 SAMPLES

Isomer/ Homologue	Amount Detected, Nanograms per Train		
	Field Blank Value	Minimum Test Run Value	Percentage[a]
Dioxins			
2378 TCDD	ND	ND	0
Other TCDD	0.2	0.9	22
Penta CDD	ND	ND	0
Hexa CDD	ND	7.8	0
Hepta CDD	0.2	70.3	0.3
Octa CDD	0.5	38.8	1.0
Furans			
2378 TCDF	ND	ND	0
Other TCDF	0.2	9.8	2.0
Penta CDF	0.2	13.3	1.5
Hexa CDF	0.4	10.4	3.8
Hepta CDF	0.5	119.4	0.4
Octa CDF	0.4	68.0	0.7

[a] Percentage shown is the ratio of the field blank value to the minimum test run value, expressed as a percentage.

TABLE 8-7. PERCENT SURROGATE RECOVERIES FOR SITE WRI-A FEED SAMPLES

Surrogate Compound	Percent Surrogate Recovery	
	Wire Insulation	Transformer Combustibles
d_4-dichlorobenzene	7	ND[a]
bromobiphenyl	133	ND
2', 5, 5' tetra bromobiphenyl	50	ND
d_6-phenol	52	29
d_4-2-chlorophenol	80	41
$^{13}C_6$-pentachlorophenol	76	64

[a] The base neutrals fractions of this sample could not be analyzed successfully by GC/MS; the sample was analyzed for total organic halogen and a chromatographic profile was obtained by gas chromatography using electron capture detection.

21 mg CL^-/liter of sample while the back-half of the blank sample train contained only 1 mg Cl^-/liter of sample. The reported concentration and emission rates are corrected by these blank values. Chlorides were not detected in the blank NaOH aliquot.

APPENDIX A

FIELD SAMPLING DATA

APPENDIX A-1

MODIFIED METHOD 5 AND EPA METHODS 1-4 FIELD RESULTS

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```
      R A D I A N   S O U R C E   T E S T
      E P A   M E T H O D   2 - 5
      ( R A W   D A T A )
    PLANT                     : SITE 06
    PLANT SITE                : ATLANTA , GA.
    SAMPLING LOCATION         : INCINERATOR OUTLET
    TEST #                    : 06-MM5-01
    DATE                      : 03/19/1985
    TEST PERIOD               : 1105-1645 (SINGLE PORT TRAVERSE)

  PARAMETER                                    VALUE
  ---------                                    -----

  Sampling time (min.)                          340
  Barometric Pressure (in.Hg)                   29.48
  Sampling nozzle diameter (in.)                .497
  Meter Volume (cu.ft.)                         91.26999
  Meter Pressure (in.H2O)                       .226
  Meter Temperature (F)                         76.2
  Stack dimension (sq.in.)                      452.3904
  Stack Static Pressure (in.H2O)               -.01
  Stack Moisture Collected (gm)                 323.33
  Absolute stack pressure(in Hg)                29.47926
  Average stack temperature (F)                 1263
  Percent CO2                                   11.8
  Percent O2                                    4.4
  Percent N2                                    83.8
  Delps Subroutine result                       4.1915
  DGM Factor                                    1.004
  Pitot Constant                                .84
```

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT                : SITE 06
PLANT SITE           : ATLANTA , GA.
SAMPLING LOCATION    : INCINERATOR OUTLET
TEST #               : 06-MM5-01
DATE                 : 03/19/1985
TEST PERIOD          : 1105-1645 (SINGLE PORT TRAVERSE)

   PARAMETER                      RESULT
   ---------                      ------

   Vm(dscf)                        88.95685
   Vm(dscm)                        2.519258
   Vw gas(scf)                     15.24501
   Vw gas (scm)                    .4317387
   % moisture                      14.63027
   Md                              .8536974
   MWd                             30.064
   MW                              28.29901
   Vs(fpm)                         625.2756
   Vs (mpm)                        190.6328
   Flow(acfm)                      1964.366
   Flow(acmm)                      55.63084
   Flow(dscfm)                     506.3257
   Flow(dscmm)                     14.33914
   % I                             120.5693
   % EA                            24.82622



                                                Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-MM5-02
DATE : 3/20/85
TEST PERIOD : 1055-1255 / 1400-1600

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.5
Sampling nozzle diameter (in.)	.685
Meter Volume (cu.ft.)	120.638
Meter Pressure (in.H2O)	.836
Meter Temperature (F)	86.8
Stack dimension (sq.in.)	452.3904
Stack Static Pressure (in.H2O)	-.01
Stack Moisture Collected (gm)	405.5
Absolute stack pressure(in Hg)	29.49927
Average stack temperature (F)	1303.041
Percent CO2	13.9
Percent O2	3.7
Percent N2	82.4
Delps Subroutine result	4.500948
DGM Factor	1.004
Pitot Constant	.84

```
                 RADIAN SOURCE TEST
                 EPA METHODS 2-5
                 FINAL RESULTS
PLANT                 : SITE 06
PLANT SITE            : ATLANTA , GA.
SAMPLING LOCATION     : INCINERATOR OUTLET
TEST #                : 06-MM5-02
DATE                  : 3/20/85
TEST PERIOD           : 1055-1255 / 1400-1600

   PARAMETER                   RESULT
   ---------                   ------

   Vm(dscf)                     115.5547
   Vm(dscm)                     3.27251
   Vw gas(scf)                  19.11933
   Vw gas (scm)                 .5414593
   % moisture                   14.19674
   Md                           .8580326
   MWd                          30.372
   MW                           28.61558
   Vs(fpm)                      667.4871
   Vs (mpm)                     203.5022
   Flow(acfm)                   2096.978
   Flow(acmm)                   59.3864
   Flow(dscfm)                  531.2741
   Flow(dscmm)                  15.04568
   % I                          111.3155
   % EA                         20.49453



                                        Program Revision:1/16/84
```

```
            R A D I A N   S O U R C E   T E S T
            E P A   M E T H O D   2 - 5
            ( R A W   D A T A )
          PLANT                : SITE 06
          PLANT SITE           : ATLANTA , GA.
          SAMPLING LOCATION    : INCINERATOR OUTLET
          TEST #               : 06-MM5-03
          DATE                 : 03/21/85
          TEST PERIOD          :
1000-1230 / 1320-1350 / 1430-1545 / 1610-1655

         PARAMETER                               VALUE
         ---------                               -----

         Sampling time (min.)                     300
         Barometric Pressure (in.Hg)              29.05
         Sampling nozzle diameter (in.)           .685
         Meter Volume (cu.ft.)                    142.2241
         Meter Pressure (in.H2O)                  .7423331
         Meter Temperature (F)                    71.63
         Stack dimension (sq.in.)                 452.3904
         Stack Static Pressure (in.H2O)          -.01
         Stack Moisture Collected (gm)            514.5301
         Absolute stack pressure(in Hg)           29.04926
         Average stack temperature (F)            1179.92
         Percent CO2                              12.3
         Percent O2                               5.2
         Percent N2                               82.5
         Delps Subroutine result                  4.09
         DGM Factor                               1.004
         Pitot Constant                           .84
```

```
          R A D I A N   S O U R C E   T E S T
          E P A   M E T H O D S   2 - 5
          F I N A L   R E S U L T S
        PLANT                  : SITE 06
        PLANT SITE             : ATLANTA , GA.
        SAMPLING LOCATION      : INCINERATOR OUTLET
        TEST #                 : 06-MM5-03
        DATE                   : 03/21/85
        TEST PERIOD            :
1000-1230 / 1320-1350 / 1430-1545 / 1610-1655

          PARAMETER                  RESULT
          ---------                  ------

          Vm(dscf)                    137.953
          Vm(dscm)                    3.906829
          Vw gas(scf)                 24.26009
          Vw gas (scm)                .6870458
          % moisture                  14.9557
          Md                          .8504431
          MWd                         30.176
          MW                          28.355
          Vs(fpm)                     614.0261
          Vs (mpm)                    187.2031
          Flow(acfm)                  1929.024
          Flow(acmm)                  54.62997
          Flow(dscfm)                 512.8233
          Flow(dscmm)                 14.52315
          % I                         110.1387
          % EA                        31.36309




                                          Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-MM5-04
DATE : 03/22/85
TEST PERIOD : 1152-1352 / 1500-1700

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	28.95
Sampling nozzle diameter (in.)	.685
Meter Volume (cu.ft.)	118.497
Meter Pressure (in.H2O)	.8164583
Meter Temperature (F)	70.07
Stack dimension (sq.in.)	452.3904
Stack Static Pressure (in.H2O)	-.01
Stack Moisture Collected (gm)	422.5
Absolute stack pressure(in Hg)	28.94927
Average stack temperature (F)	1232.917
Percent CO2	10.2
Percent O2	6.8
Percent N2	83
Delps Subroutine result	4.339637
DGM Factor	1.004
Pitot Constant	.84

```
    R A D I A N   S O U R C E   T E S T
    E P A   M E T H O D S   2 - 5
    F I N A L   R E S U L T S
PLANT                : SITE 06
PLANT SITE           : ATLANTA , GA.
SAMPLING LOCATION    : INCINERATOR OUTLET
TEST #               : 06-MM5-04
DATE                 : 03/22/85
TEST PERIOD          : 1152-1352 / 1500-1700

    PARAMETER                  RESULT
    ---------                  ------

    Vm(dscf)                    114.9022
    Vm(dscm)                    3.254031
    Vw gas(scf)                 19.92088
    Vw gas (scm)                .5641591
    % moisture                  14.77557
    Md                          .8522443
    MWd                         29.904
    MW                          28.14512
    Vs(fpm)                     655.057
    Vs (mpm)                    199.7125
    Flow(acfm)                  2057.927
    Flow(acmm)                  58.28049
    Flow(dscfm)                 529.2591
    Flow(dscmm)                 14.98862
    % I                         111.1083
    % EA                        44.99736




                                             Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-MM5-05
DATE : 03/25/1985
TEST PERIOD : 1105-1305 / 1430-1630

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.55
Sampling nozzle diameter (in.)	.685
Meter Volume (cu.ft.)	126.178
Meter Pressure (in.H2O)	.942
Meter Temperature (F)	81.03
Stack dimension (sq.in.)	452.3904
Stack Static Pressure (in H2O)	-.01
Stack Moisture Collected (gm)	366.8
Absolute stack pressure(in Hg)	29.54926
Average stack temperature (F)	1204.04
Percent CO2	9.2
Percent O2	10.3
Percent N2	80.5
Delps Subroutine result	4.8709
DGM Factor	1.004
Pitot Constant	.84

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT              : SITE 06
PLANT SITE         : ATLANTA , GA.
SAMPLING LOCATION  : INCINERATOR OUTLET
TEST #             : 06-MM5-05
DATE               : 03/25/1985
TEST PERIOD        : 1105-1305 / 1430-1630

   PARAMETER                  RESULT
   ---------                  ------

   Vm(dscf)                    122.3891
   Vm(dscm)                    3.466058
   Vw gas(scf)                 17.29462
   Vw gas (scm)                .4897837
   % moisture                  12.38128
   Md                          .8761872
   MWd                         29.884
   MW                          28.41261
   Vs(fpm)                     724.3131
   Vs (mpm)                    220.8272
   Flow(acfm)                  2275.502
   Flow(acmm)                  64.44223
   Flow(dscfm)                 624.7833
   Flow(dscmm)                 17.69386
   % I                         100.2536
   % EA                        94.04676




                                        Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-MM5-06
DATE : 03/26/1985
TEST PERIOD : 1220-1420 / 1455-1655

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.51
Sampling nozzle diameter (in.)	.685
Meter Volume (cu.ft.)	119.283
Meter Pressure (in.H2O)	.791
Meter Temperature (F)	87.16001
Stack dimension (sq.in.)	452.3904
Stack Static Pressure (in.H2O)	-.01
Stack Moisture Collected (gm)	316.2
Absolute stack pressure(in Hg)	29.50927
Average stack temperature (F)	1308
Percent CO2	7.7
Percent O2	8.899999
Percent N2	83.4
Delps Subroutine result	4.6224
DGM Factor	1.004
Pitot Constant	.84

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT                : SITE 06
PLANT SITE           : ATLANTA , GA.
SAMPLING LOCATION    : INCINERATOR OUTLET
TEST #               : 06-MM5-06
DATE                 : 03/26/1985
TEST PERIOD          : 1220-1420 / 1455-1655

   PARAMETER                RESULT
   ---------                ------

   Vm(dscf)                  114.2075
   Vm(dscm)                  3.234356
   Vw gas(scf)               14.90883
   Vw gas (scm)              .4222181
   % moisture                11.54682
   Md                        .8845318
   MWd                       29.588
   MW                        28.24996
   Vs(fpm)                   689.8033
   Vs (mpm)                  210.3059
   Flow(acfm)                2167.086
   Flow(acmm)                61.37187
   Flow(dscfm)               564.5963
   Flow(dscmm)               15.98937
   % I                       103.5245
   % EA                      67.84776




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```

APPENDIX A-2

CONTINUOUS EMISSION MONITORING RESULTS

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CEMS DATA - SITE 06 - TEST 1

NORMALIZED / CORRECTED DATA - WITH ACTUAL O2 *

	FACTOR FOR 3% O2 NORMALIZATION OF OTHER PROCESS GASES	TIME	O2 (%V)	CO (PPMV) @ 3% O2	CO2 (%V) @ 3% O2	NOX (PPMV) @ 3% O2	THC (PPMV) @ 3% O2
	1.0932	1120	4.5	3914.1	12.6	61.7	
	0.9734	1125	2.5	6042.6	13.3	37.5	
	0.9968	1130	2.9	6188.7	13.3	37.0	210.9
	0.9710	1135	2.5	6029.7	13.1	35.1	188.8
	0.9717	1140	2.5	6035.3	13.2	34.7	122.8
	1.0309	1145	3.5	6404.4	14.6	43.4	65.7
	0.9841	1150	2.7	6114.9	14.1	35.6	47.9
	0.8961	1155	0.9	4724.0	11.0	7.3	14.8
	1.0336	1200	3.6	430.3	11.1	60.0	3.6
	1.1022	1205	4.7	148.3	11.0	76.7	3.4
	1.0845	1210	4.4	231.4	11.7	74.1	3.2
	1.1033	1215	4.7	587.6	11.5	69.2	3.6
	1.1592	1220	5.5	119.3	11.4	79.1	3.6
	1.4011	1225	8.1	132.2	11.1	96.8	4.3
	1.4946	1230	8.9	109.2	11.6	113.4	4.5
	1.6342	1235	9.9	116.8	11.7	129.1	4.6
	1.8516	1240	11.2	109.6	11.5	103.5	5.1
	1.0465	1245	3.8	3477.4	11.8	54.8	2.9
	0.9538	1250	2.1	5939.2	14.0	80.9	16.2
	1.0175	1255	3.3	6337.2	15.5	115.4	71.9
	1.0065	1300	3.1	6269.8	15.3	103.4	87.0
	1.0064	1305	3.1	6250.6	14.7	105.3	61.9
	0.9654	1310	2.4	6016.1	12.6	97.0	70.6
	0.9842	1315	2.7	1523.2	11.5	51.5	18.5
	1.0569	1320	4.0	109.6	11.8	52.5	6.3
	1.0771	1325	4.3	94.5	11.7	61.3	2.8
	0.9787	1330	2.6	2277.5	11.9	66.2	2.5
	0.9571	1335	2.2	5270.7	11.9	70.6	2.4
	0.9936	1340	2.9	6198.7	14.9	107.8	12.1
	0.9885	1345	2.8	6160.1	15.1	102.5	2.4
	1.0109	1350	3.2	6308.7	14.7	103.8	51.8
	1.0174	1355	3.3	1547.0	11.2	60.9	79.9
	1.2617	1400	6.7	79.6	11.1	80.2	58.1
	1.8960	1405	11.5	91.7	11.0	175.7	4.4
	1.5200	1410	9.1	622.2	12.0	87.9	3.5
	1.0026	1415	3.0	4431.2	11.8	59.7	2.2
	0.9675	1420	2.4	2248.1	11.8	40.2	2.2
	1.0157	1425	3.3	155.7	11.6	50.7	11.3
	1.0354	1430	3.6	348.7	11.7	54.8	14.0
	0.9682	1435	2.4	2109.8	11.7	60.1	2.2
	0.9136	1440	1.3	5074.8	12.2	63.6	2.0
	0.9830	1445	2.7	6147.2	15.1	88.0	2.2
	0.9791	1450	2.6	6123.9	14.8	58.9	13.5
	0.9875	1455	2.8	6177.7	14.9	40.8	59.3
	0.9866	1500	2.8	6173.1	14.6	73.4	95.0
	0.9882	1505	2.8	6184.2	14.6	47.8	59.5
	1.0033	1510	3.1	6279.8	14.7	68.4	28.2
	1.0473	1515	3.8	693.0	11.1	63.1	40.3
	1.3021	1520	7.2	111.8	11.0	100.6	50.7
	1.6809	1525	10.3	112.6	10.9	120.6	54.3
	1.9195	1530	11.6	97.8	11.1	198.4	3.7
	1.1844	1535	5.0	2447.1	12.3	72.8	2.1
	1.1785	1540	5.7	7384.9	17.3	133.0	2.1
	1.2273	1545	6.3	7322.3	14.4	99.1	2.0
NO. PTS.	54	NO. PTS.	54	54	54	54	52
MEAN	1.1276	MEAN	4.4	3363.8	12.7	77.4	32.5
STD. DEV.	0.3	STD. DEV.	2.7	2751.1	1.6	34.6	45.3

* CO, CO2, NOX and THC values are corrected to 3% O2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

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CEMS DATA - SITE 06 - TEST 2

```
**        FACTOR         **          NORMALIZED / CORRECTED DATA - WITH ACTUAL O2 *
**       FOR 3% O2       **
**     NORMALIZATION     **
**          OF           **
**     OTHER PROCESS     **        TIME       O2        CO      CO2      NOX      THC
**         GASES         **                 (%V)    (PPMV)     (%V)   (PPMV)   (PPMV)
**                       **                        @ 3% O2  @ 3% O2  @ 3% O2  @ 3% O2
**      ==========       **     =======  =======   =======  =======  =======  =======
**                       **
**        0.9840         **         935      2.7    6304.1     16.5    146.6
**        0.9466         **         940      2.0    5944.8     14.8    121.7
**        0.9176         **         945      1.4    4996.8     13.2     75.5
**        1.0049         **         950      3.1    3036.4     12.6     76.1
**        0.9502         **         955      2.1     628.1     13.0     77.3
**        1.0631         **        1000      4.1     101.9     12.7     95.6
**        1.2710         **        1005      6.8      75.3     13.2    128.4
**        1.4743         **        1010      8.8               13.2    152.9
**        1.6744         **        1015     10.2               13.4    174.3
**        1.8820         **        1020     11.4      97.5     13.5    198.4
**        1.6649         **        1025     10.1     403.7     13.3    117.0
**        1.0265         **        1030      3.5    1380.1     13.4     53.0
**        0.8925         **        1035      0.8    5562.7     14.2     79.6
**        0.9090         **        1040      1.2    3377.6     13.8     63.2
**        0.9912         **        1045      2.8     834.0     13.3     46.5
**        0.9271         **        1050      1.6    4802.4     14.9     84.2
**        0.9730         **        1055      2.5    6148.4     17.1     98.9
**        1.0025         **        1100      3.0    6193.7     16.2     98.8
**        0.8785         **        1105      0.5    5541.6     12.8     46.9
**        0.9323         **        1110      1.7    5403.3     12.8     52.2
**        0.9455         **        1115      2.0    3313.3     13.2     50.6
**        0.8858         **        1120      0.7    4567.9     12.7     47.9
**        0.9517         **        1125      2.1    1598.5     11.7     43.6
**        1.1362         **        1130      5.1     314.4     12.6     75.6
**        1.3895         **        1135      8.0     366.5     12.0    114.6
**        1.9301         **        1140     11.6     493.7     13.9    148.3
**        0.9775         **        1145      2.6    5569.0     16.9    108.2
**        0.9732         **        1150      2.5    6092.0     17.0    110.0    204.2
**        0.9743         **        1155      2.5    6087.4     16.3     98.6     60.9
**        0.9726         **        1200      2.5    6077.9     16.8     90.7    102.8
**        0.9740         **        1205      2.5    6081.5     16.7     90.7    171.7
**        0.9407         **        1210      2.0    5918.3     15.6    103.1      5.9
**        0.9517         **        1215      2.1    5931.7     15.9    112.3
**        0.9714         **        1220      2.5    6049.8     16.5    102.9
**        0.8716         **        1225      0.4    5110.4     12.0     63.2
**        0.9125         **        1230      1.3     731.4     12.4     49.6    744.6
**        1.1379         **        1235      5.2     192.4     12.6     78.9   1978.5
**        1.2053         **        1240      6.0     195.6     12.7    103.8   2269.8
**        1.3479         **        1245      7.6     198.7     12.4    115.1   1080.2
**        1.5976         **        1250      9.7    2335.3     14.1    142.5   1006.0
**        0.9810         **        1255      2.7    6073.0     17.0    127.7    578.3
**        0.9745         **        1300      2.5    6028.0     17.0     96.4    443.9
**        0.9615         **        1305      2.3    5769.3     13.6     83.8    836.4
**        0.8870         **        1310      0.7    4799.3     13.2     85.4   1246.7
**        0.9981         **        1315      3.0    6088.3     15.9    163.6    342.6
**        0.9761         **        1320      2.6    6016.9     16.1    112.9     22.5
**        0.9730         **        1325      2.5    5997.6     16.1     50.3      0.4
**        0.9750         **        1330      2.5    6000.2     16.3     44.7
**        0.9930         **        1335      2.9    6105.9     16.5    118.4
**        0.9754         **        1340      2.5    5992.5     16.2     46.6
**        0.9475         **        1345      2.0    3540.2     13.7     34.7    638.5
**        1.0072         **        1350      3.1     170.3     12.0     80.4   1184.3
**        1.1893         **        1355      5.8     174.9     12.2    118.7    908.9
**        1.3223         **        1400      7.4     177.6     12.6    136.5    503.0
**        1.3937         **        1405      8.1     186.5     11.9    136.9    477.2
**        1.4530         **        1410      8.6     206.9     12.5    151.1   1309.8
**        1.1457         **        1415      5.3    1864.9     13.0     85.5   1927.0
**        0.8939         **        1420      0.9    4418.2     13.5     58.0    909.0
**        0.9468         **        1425      2.0    4913.1     13.0     64.7   1012.5
**        0.9827         **        1430      2.7    5986.6     17.1    159.9   1241.1
**        0.9755         **        1435      2.6    5937.7 [illegible]   89.8    809.3
**        0.9848         **        1440      2.7    5989.3 [illegible]   46.3    188.9
**        0.9970         **        1445      2.9    6058.6     16.8    215.4      8.5
**        0.9858         **        1450      2.7    5985.2     16.5    174.1      3.9
**        1.0415         **        1455      3.7    5628.5     13.6    169.5      3.4
**        0.9779         **        1500      2.6    5927.3     16.1    243.7      2.8
**        0.9799         **        1505      2.6    5934.3     16.6     58.3      3.3
==========================================================================================

NO. PTS.         67                NO. PTS.       67        65       67       67       34
MEAN         1.0797                MEAN          3.7    3846.9     14.4    101.2    653.7
STD. DEV.       0.2                STD. DEV.     2.0    2463.5      1.8     44.9    615.6
```

* CO, CO2 NOX and THC values are corrected to 3% O2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

CEMS DATA - SITE 06 - TEST 3

FACTOR FOR 3% O2 NORMALIZATION OF OTHER PROCESS GASES	NORMALIZED / CORRECTED DATA - WITH ACTUAL 02 * TIME	O2 (%V)	CO (PPMV) @ 3% O2	CO2 (%V) @ 3% O2	NOX (PPMV) @ 3% O2	THC (PPMV) @ 3% O2
0.8621	1025	0.1	5313.1	11.1	2.6	30.1
0.8761	1030	0.5	534.0	10.6	13.3	33.5
1.0200	1035	3.4	279.9	11.5	62.3	3.7
0.9750	1040	2.5	2741.6	11.2	16.2	1.9
0.9473	1045	2.0	3931.2	11.2	14.7	19.6
0.9253	1050	1.6	4675.0	10.0	27.0	83.3
8.5401	1055	10.0	4556.2	14.6	171.5	2554.5
1.2193	1100	6.2	4486.9	12.7	90.1	209.2
1.0399	1105	3.7	6732.9	14.7	39.8	80.2
1.0454	1110	3.8	6151.0	13.0	28.1	1223.0
1.0211	1115	3.4	412.8	10.6	59.2	1809.5
1.1237	1120	5.0	286.8	10.2	81.2	1062.6
1.3854	1125	0.0	286.0	10.6	111.0	523.0
1.8987	1130	11.5	139.3	11.8	158.2	252.1
1.7695	1135	10.8	3388.2	14.5	90.9	83.1
1.2137	1140	6.2	7755.9	17.3	44.1	10.5
1.0813	1145	4.3	7010.5	16.6	41.3	7.0
1.0691	1150	4.2	6941.1	15.8	41.1	1406.7
1.1030	1155	4.7	7169.0	16.5	42.5	1744.6
1.0355	1200	3.6	6727.2	15.4	38.7	3294.2
1.0358	1205	3.6	6731.3	15.3	36.1	3300.9
1.1290	1210	5.0	7339.6	17.2	43.4	3604.1
1.1056	1215	4.7	7109.8	16.8	42.7	3536.0
1.1038	1220	4.7	7100.4	17.1	42.6	3535.0
1.0482	1225	3.8	6820.8	16.9	36.7	3362.5
1.0469	1230	3.8	6814.6	16.9	39.5	3362.4
1.0694	1235	4.2	6963.2	17.3	43.7	2681.1
0.9754	1240	2.5	5144.8	13.8	20.0	2098.1
0.9709	1245	2.5	294.0	11.2	38.9	1531.1
1.2190	1250	6.2	191.4	11.1	65.0	1949.6
1.3513	1255	7.7	299.8	11.2	79.2	2000.3
1.5734	1300	9.5	277.1	10.0	89.7	902.5
1.7061	1305	10.4	288.9	11.4	114.2	304.3
1.5959	1310	9.7	314.0	10.6	93.4	112.3
1.0238	1315	3.4	5140.7	14.2	74.3	35.4
1.0046	1320	3.1	6197.7	13.1	55.2	22.8
1.0555	1325	3.9	6894.4	15.4	44.3	16.9
1.1269	1330	5.0	7362.8	16.0	40.4	15.5
1.0675	1335	4.1	6977.5	15.4	40.4	326.2
1.0677	1340	4.1	6980.7	15.3	43.5	590.9
1.0185	1345	3.3	6661.0	13.6	55.4	574.4
0.9233	1350	1.5	2700.6	10.8	20.9	2301.1
0.9532	1355	2.1	369.0	9.9	2.4	2790.8
1.2017	1400	6.0	253.7	10.6	5.4	2445.1
1.3458	1405	7.6	275.1	10.0	57.7	1752.2
1.6185	1410	9.8	297.7	10.7	111.7	1202.8
1.1420	1415	5.2	6729.9	16.4	37.5	380.8
1.0910	1420	4.5	7151.1	16.7	46.0	149.9
1.1305	1425	5.1	7322.1	14.9	42.0	96.3
1.0536	1430	3.9	6910.3	15.8	41.2	35.5
1.0491	1435	3.8	6883.5	15.7	36.9	16.0
1.0733	1440	4.2	7044.5	16.1	38.1	290.1
1.0946	1445	4.5	7186.3	16.3	38.5	1063.9
1.0903	1450	4.5	7160.7	16.3	38.3	3155.4
1.3662	1455	7.8	8975.4	18.2	50.0	4575.4
1.2870	1500	7.0	8463.2	17.6	46.3	4320.0
1.3440	1505	7.6	8567.1	16.3	44.6	4516.6
1.2854	1510	7.0	8452.4	17.8	62.4	4325.9
1.2763	1515	6.9	8395.7	17.8	51.2	4272.9

NO. PTS.	59	NO. PTS.	59	59	59	59	59
MEAN	1.2843	MEAN	5.2	4823.5	14.1	52.4	1474.2
STD. DEV.	1.0	STD. DEV.	3.0	3031.8	2.6	32.9	1486.1

* CO, CO2, NOX and THC values are corrected to 3% O2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

CEMS DATA - SITE 06 - TEST 4

	FACTOR FOR 3% O2 NORMALIZATION OF OTHER PROCESS GASES	TIME	O2 (%V)	CO (PPMV) @ 3% O2	CO2 (%V) @ 3% O2	NOX (PPMV) @ 3% O2	THC (PPMV) @ 3% O2
			NORMALIZED / CORRECTED DATA - WITH ACTUAL O2 *				
	0.8828	1025	0.6	3510.6	11.5	101.0	145.5
	0.8956	1030	0.9	2894.9	11.5	103.5	237.7
	0.9405	1035	1.9	3200.6	11.7	116.6	445.1
	0.8737	1040	0.4	5398.5	11.5	120.5	305.5
	0.8814	1045	0.6	4107.6	11.3	101.4	295.9
	0.9880	1050	2.8	627.9	9.8	88.6	540.7
	1.0923	1150	4.5	7009.6	15.1	187.2	
	1.0605	1155	4.0	6807.3	14.4	193.2	
	1.0881	1200	4.4	6907.5	13.7	151.5	
	1.1193	1205	4.9	7189.9	14.7	189.6	20.3
	1.1401	1210	5.2	7326.4	14.5	186.0	644.3
	1.1921	1215	5.9	7663.4	15.4	185.0	2870.2
	1.1822	1220	5.8	7602.1	15.7	169.4	3483.4
	1.2129	1225	6.1	7002.2	16.0	134.5	31.3
	1.0630	1230	4.1	2935.4	11.4	61.4	674.3
	1.1337	1235	5.1	214.5	11.1	58.6	1560.2
	1.2233	1240	6.3	213.5	11.1	29.6	1315.0
	1.3254	1245	7.4	249.9	11.1	100.0	951.1
	1.4065	1250	8.2	296.7	11.3	109.9	685.3
	1.4536	1255	8.6	297.7	11.3	110.2	240.1
	1.5103	1300	9.1	282.0	11.3	123.1	99.0
	1.6392	1305	10.0	325.7	10.8	124.6	62.0
	1.6100	1310	9.8	331.9	11.4	133.7	47.4
	1.6223	1315	9.9	288.0	11.3	136.3	43.4
	1.6821	1320	10.3	256.5	11.1	138.2	42.0
	1.8212	1325	11.1	400.4	11.3	151.2	47.6
	1.8464	1330	11.2	400.7	11.2	155.9	44.9
	1.9267	1335	11.6	314.2	11.0	172.7	49.3
	1.9882	1340	11.9	422.3	10.7	201.0	40.0
	2.1801	1345	12.7	418.6	10.3	184.1	59.1
	2.3791	1350	13.4	491.0	10.6	220.3	59.0
	2.0480	1355	12.2	503.0	10.9	182.7	53.6
	1.1057	1400	4.7	6946.4	14.8	126.7	28.2
	1.1280	1405	5.0	7307.7	15.3	146.4	27.1
	1.0940	1410	4.6	7095.1	15.0	132.5	26.7
	1.0881	1415	4.4	7053.6	14.7	135.6	26.2
	1.1430	1420	5.2	7417.4	14.4	150.0	28.8
	1.2521	1425	6.6	8122.8	14.5	140.2	28.8
	1.3211	1430	7.4	8573.6	15.0	162.7	357.2
	1.3760	1435	7.9	8933.2	15.4	146.5	767.5
	1.3524	1440	7.7	8782.0	15.2	151.3	847.8
	1.4837	1445	8.8	9638.7	16.3	162.2	1000.3
	1.4438	1450	8.5	9303.2	16.1	144.1	936.7
	1.2995	1455	7.1	8440.3	15.2	102.6	2507.6
	1.2337	1500	6.4	1960.5	11.2	82.6	3750.0
	1.1717	1505	5.6	140.1	11.4	97.5	4099.2
	1.2841	1510	7.0	107.9	11.5	109.0	5761.3
NO. PTS.	47	NO. PTS.	47	47	47	47	44
MEAN	1.3440	MEAN	6.8	3972.3	12.8	136.8	802.4
STD. DEV.	0.4	STD. DEV.	3.3	3521.6	2.0	39.5	1200.0

* CO, CO2, NOX and THC values are corrected to 3% O2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

CEMS DATA - SITE 06 - TEST 5

NORMALIZED / CORRECTED DATA - WITH ACTUAL O2 *

FACTOR FOR 3% O2 NORMALIZATION OF OTHER PROCESS GASES	TIME	O2 (%V)	CO (PPMV) @ 3% O2	CO2 (%V) @ 3% O2	NOX (PPMV) @ 3% O2	THC (PPMV) @ 3% O2
3.3103	950	15.5	102.2	11.9	170.9	
3.0930	955	15.1	110.0	11.8	156.3	
2.6110	1000	14.0	104.3	12.1	105.3	
1.8661	1005	11.3	1581.0	13.3	74.8	
1.5613	1010	9.4	7541.2	14.6	70.1	
1.6691	1015	10.2	10881.7	19.1	123.6	33.3
1.4466	1020	8.5	9431.1	15.0	75.4	225.4
1.5569	1025	9.4	10030.7	15.0	83.7	880.4
1.8353	1030	11.1	11965.4	19.9	145.9	926.0
1.5711	1035	9.5	10242.8	18.4	183.2	419.2
1.7783	1040	10.8	11593.9	18.7	176.0	565.3
1.6100	1045	9.8	10540.7	18.8	164.4	1498.4
1.4173	1050	8.3	7960.1	14.4	81.0	1496.2
1.7783	1055	10.8	277.4	12.9	108.0	2474.0
2.2090	1100	12.8		13.0	161.1	679.7
2.3103	1105	13.2		13.0	182.0	214.5
2.0536	1110	12.2	6765.2	19.1	293.9	50.7
1.5066	1115	9.0	9822.7	20.1	367.1	12.3
1.4169	1120	8.3	9238.0	19.6	345.4	5.4
1.5872	1125	9.6	10348.0	20.5	323.5	65.2
1.5873	1130	9.6	10348.9	20.1	338.9	536.0
1.5645	1135	9.5	10076.3	19.0	313.7	213.1
1.4940	1140	8.9	9745.6	19.5	339.8	113.5
1.5995	1145	9.7	10428.4	19.9	349.4	24.0
1.8421	1150	11.2	12009.9	20.8	345.0	29.3
1.7300	1155	10.6	11284.4	20.7	276.0	179.0
1.6069	1200	9.8	10476.6	20.1	242.0	167.5
1.8712	1205	11.3	11461.0	19.5	224.6	538.1
1.6171	1210	9.8	10542.7	20.6	178.0	1173.9
1.5395	1215	9.3	10036.8	17.4	123.5	999.0
1.4480	1220	8.5	8463.6	13.4	73.9	1500.4
1.5129	1225	9.1	4246.3	14.0	90.9	1646.7
1.3917	1230	8.0	878.7	14.0	99.4	975.8
1.5926	1235	9.7		14.1	131.0	752.0
1.4812	1240	8.8		13.7	131.5	492.9
1.3300	1245	7.4		13.6	148.9	156.6
1.3824	1250	8.0		13.3	163.9	38.4
1.6571	1255	10.1		13.7	175.3	11.2
1.8146	1300	11.0		13.9	181.0	8.9
1.6494	1305	10.0		13.9	181.6	7.1
1.5591	1310	9.4		14.1	179.0	5.2
1.4966	1315	8.9		13.9	178.2	3.6
1.3500	1320	7.7		13.5	182.2	4.2
1.4718	1325	8.7		13.5	190.2	4.0
1.7132	1330	10.5		13.4	192.5	3.8
1.6057	1335	9.8		13.6	192.9	3.6
1.5962	1340	9.7		13.1	189.8	2.7
1.7743	1345	10.8		13.5	201.3	4.6
1.5641	1350	9.5		13.6	199.4	3.7
1.2795	1355	6.9		13.3	159.1	1.0
1.4541	1400	8.6		13.7	175.2	3.7
1.5600	1405	9.4		13.6	176.1	3.9
1.5841	1410	9.6		13.7	190.7	13.0
1.8928	1415	11.4		13.6	200.0	8.9
1.9538	1420	11.7		15.5	215.7	5.9
2.4507	1425	13.6		11.7	186.6	8.8
2.2014	1430	12.8		14.0	220.5	8.9
2.0720	1435	12.3		13.8	230.5	7.9
3.1602	1440	15.2		9.6	189.0	12.6

NO. PTS.	59	NO. PTS.	59	31	59	59	54
MEAN	1.7568	MEAN	10.3	8017.8	15.4	189.0	355.9
STD. DEV.	0.4	STD. DEV.	1.9	3991.6	3.0	76.3	549.1

* CO, CO2, NOX and THC values are corrected to 3% O2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

```
CEMS DATA - SITE 06 - TEST 6

**       FACTOR            **               NORMALIZED / CORRECTED DATA - WITH
**       FOR 3% O2         **                  ACTUAL O2 *
**       NORMALIZATION     **
**            OF           **
**       OTHER PROCESS     **       TIME        O2        CO       CO2       THC
**           GASES         **                  (%V)    (PPMV)      (%V)    (PPMV)
**                         **                @ 3% O2  @ 3% O2   @ 3% O2   @ 3% O2
**       ==========        **      =======  =======  =======   =======   =======
**                         **
**         1.1174          **         1300      4.9  10776.9      11.4     314.2
**         1.4818          **         1330      8.8   1950.0      12.0      36.5
**         2.3772          **         1400     13.4    132.8      11.7      26.6
**         2.0226          **         1430     12.1   2901.2      12.2      25.3
**         1.1139          **         1500      4.8  12724.4      10.7     147.1
**         1.7900          **         1530     10.9   2247.0      12.6     145.0
**         1.2980          **         1600      7.1  16589.8      10.5     307.6
==================================================================================

NO. PTS.         7                    NO. PTS.        7        7         7         7
MEAN        1.6001                    MEAN          8.9   6760.3      11.6     143.2
STD. DEV.      0.4                    STD. DEV.     3.2   5983.9       0.7     116.6

                                      *  CO, CO2, NOX and THC values are corrected to 3% O2.
                                      To obtain actual measured values, divide values in the
                                      table by the corresponding normalization factor.
```

APPENDIX A-3

HCl TRAIN RESULTS

```
      R A D I A N   S O U R C E   T E S T
      E P A   M E T H O D   2 - 5
      ( R A W   D A T A )
   PLANT                 : SITE 06
   PLANT SITE            : ATLANTA , GA.
   SAMPLING LOCATION     : INCINERATOR OUTLET
   TEST #                : 06-HCL-01
   DATE                  : 03/19/1985
   TEST PERIOD           : 1148-1348

 PARAMETER                                  VALUE
 ---------                                  -----

 Sampling time (min.)                        120
 Barometric Pressure (in.Hg)                 29.48
 Sampling nozzle diameter (in.)              .485
 Meter Volume (cu.ft.)                       44.61
 Meter Pressure (in.H2O)                     .41
 Meter Temperature (F)                       77.2
 Stack dimension (sq.in.)                    452.3904
 Stack Static Pressure (in.H2O)             -.01
 Stack Moisture Collected (gm)               152
 Absolute stack pressure(in Hg)              29.47926
 Average stack temperature (F)               1293.2
 Percent CO2                                 11.8
 Percent O2                                  4.4
 Percent N2                                  83.8
 Delps Subroutine result                     5.3927
 DGM Factor                                  .9945
 Pitot Constant                              .84
```

```
          R A D I A N   S O U R C E   T E S T
          E P A   M E T H O D S   2 - 5
          F I N A L   R E S U L T S
        PLANT                  : SITE 06
        PLANT SITE             : ATLANTA , GA.
        SAMPLING LOCATION      : INCINERATOR OUTLET
        TEST #                 : 06-HCL-01
        DATE                   : 03/19/1985
        TEST PERIOD            : 1148-1348

          PARAMETER                      RESULT
          ---------                      ------

          Vm(dscf)                        43.00755
          Vm(dscm)                        1.217974
          Vw gas(scf)                     7.1668
          Vw gas (scm)                    .2029638
          % moisture                      14.28379
          Md                              .8571621
          MWd                             30.064
          MW                              28.3408
          Vs(fpm)                         803.8736
          Vs (mpm)                        245.0834
          Flow(acfm)                      2525.449
          Flow(acmm)                      71.52072
          Flow(dscfm)                     642.3315
          Flow(dscmm)                     18.19083
          % I                             136.7098
          % EA                            24.82622



                                          Program Revision:1/16/84
```

```
       R A D I A N   S O U R C E   T E S T
       E P A   M E T H O D   2 - 5
       ( R A W   D A T A )
    PLANT                : SITE 06
    PLANT SITE           : ATLANTA , GA.
    SAMPLING LOCATION    : INCINERATOR OUTLET
    TEST #               : 06-HCL-02
    DATE                 : 03/19/1985
    TEST PERIOD          : 1505-1635

  PARAMETER                              VALUE
  ---------                              -----

  Sampling time (min.)                    90
  Barometric Pressure (in.Hg)             29.48
  Sampling nozzle diameter (in.)          .485
  Meter Volume (cu.ft.)                   31.93
  Meter Pressure (in.H20)                 .38
  Meter Temperature (F)                   87.56
  Stack dimension (sq.in.)                452.3904
  Stack Static Pressure (in.H20)         -.01
  Stack Moisture Collected (gm)           102.78
  Absolute stack pressure(in Hg)          29.47926
  Average stack temperature (F)           1228
  Percent CO2                             11.8
  Percent O2                              4.4
  Percent N2                              83.8
  Delps Subroutine result                 5.1184
  DGM Factor                              .9945
  Pitot Constant                          .84
```

```
     R A D I A N   S O U R C E   T E S T
     E P A   M E T H O D S   2 - 5
     F I N A L   R E S U L T S
PLANT                 : SITE 06
PLANT SITE            : ATLANTA , GA.
SAMPLING LOCATION     : INCINERATOR OUTLET
TEST #                : 06-HCL-02
DATE                  : 03/19/1985
TEST PERIOD           : 1505-1635

     PARAMETER                  RESULT
     ---------                  ------

     Vm(dscf)                    30.19835
     Vm(dscm)                    .8552172
     Vw gas(scf)                 4.846077
     Vw gas (scm)                .1372409
     % moisture                  13.82838
     Md                          .8617161
     MWd                         30.064
     MW                          28.39575
     Vs(fpm)                     762.2461
     Vs (mpm)                    232.3921
     Flow(acfm)                  2394.673
     Flow(acmm)                  67.81713
     Flow(dscfm)                 635.9558
     Flow(dscmm)                 18.01027
     % I                         129.2734
     % EA                        24.82622



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```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-HCL-03
DATE : 03/20/1985
TEST PERIOD : 1050-1250

PARAMETER	VALUE
Sampling time (min.)	120
Barometric Pressure (in.Hg)	29.5
Sampling nozzle diameter (in.)	.685
Meter Volume (cu.ft.)	60.665
Meter Pressure (in.H2O)	.839
Meter Temperature (F)	84.04
Stack dimension (sq.in.)	452.3904
Stack Static Pressure (in.H2O)	-.01
Stack Moisture Collected (gm)	215.2
Absolute stack pressure(in Hg)	29.49927
Average stack temperature (F)	1282.75
Percent CO2	13.9
Percent O2	3.7
Percent N2	82.4
Delps Subroutine result	4.4092
DGM Factor	.9945
Pitot Constant	.84

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT                : SITE 06
PLANT SITE           : ATLANTA , GA.
SAMPLING LOCATION    : INCINERATOR OUTLET
TEST #               : 06-HCL-03
DATE                 : 03/20/1985
TEST PERIOD          : 1050-1250

   PARAMETER                 RESULT
   ---------                 ------

   Vm(dscf)                   57.85139
   Vm(dscm)                   1.638351
   Vw gas(scf)                10.14668
   Vw gas (scm)               .287354
   % moisture                 14.92201
   Md                         .8507799
   MWd                        30.372
   MW                         28.52585
   Vs(fpm)                    654.9088
   Vs (mpm)                   199.6673
   Flow(acfm)                 2057.462
   Flow(acmm)                 58.26732
   Flow(dscfm)                522.8744
   Flow(dscmm)                14.8078
   % I                        113.2486
   % EA                       20.49453




                                              Program Revision:1/16/84
```

```
           R A D I A N   S O U R C E   T E S T
           E P A   M E T H O D   2 - 5
           ( R A W   D A T A )
         PLANT               : SITE 06
         PLANT SITE          : ATLANTA , GA.
         SAMPLING LOCATION   : INCINERATOR OUTLET
         TEST #              : 06-HCL-04
         DATE                : 03/21/1985
         TEST PERIOD         : 0957-1227

        PARAMETER                            VALUE
        ---------                            -----

        Sampling time (min.)                  150
        Barometric Pressure (in.Hg)           29.05
        Sampling nozzle diameter (in.)        .685
        Meter Volume (cu.ft.)                 82.514
        Meter Pressure (in.H2O)               .79
        Meter Temperature (F)                 74.73001
        Stack dimension (sq.in.)              452.3904
        Stack Static Pressure (in.H2O)       -.01
        Stack Moisture Collected (gm)         294.25
        Absolute stack pressure(in Hg)        29.04926
        Average stack temperature (F)         1198.5
        Percent CO2                           12.3
        Percent O2                            5.2
        Percent N2                            82.5
        Delps Subroutine result               4.0725
        DGM Factor                            .9945
        Pitot Constant                        .84
```

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT                : SITE 06
PLANT SITE           : ATLANTA , GA.
SAMPLING LOCATION    : INCINERATOR OUTLET
TEST #               : 06-HCL-04
DATE                 : 03/21/1985
TEST PERIOD          : 0957-1227

   PARAMETER                RESULT
   ---------                ------

   Vm(dscf)                  78.82861
   Vm(dscm)                  2.232426
   Vw gas(scf)               13.87389
   Vw gas (scm)              .3929085
   % moisture                14.96604
   Md                        .8503396
   MWd                       30.176
   MW                        28.35374
   Vs(fpm)                   611.4126
   Vs (mpm)                  186.4063
   Flow(acfm)                1920.814
   Flow(acmm)                54.39744
   Flow(dscfm)               504.8585
   Flow(dscmm)               14.29759
   % I                       127.8559
   % EA                      31.36309



                                      Program Revision:1/16/84
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D   2 - 5
   ( R A W   D A T A )
 PLANT                : SITE 06
 PLANT SITE           : ATLANTA , GA.
 SAMPLING LOCATION    : INCINERATOR OUTLET
 TEST #               : 06-HCL-05
 DATE                 : 03/22/1985
 TEST PERIOD          : 1147-1337

PARAMETER                              VALUE
---------                              -----

Sampling time (min.)                    110
Barometric Pressure (in.Hg)             28.98
Sampling nozzle diameter (in.)          .685
Meter Volume (cu.ft.)                   62.025
Meter Pressure (in.H2O)                 1.03
Meter Temperature (F)                   74.36
Stack dimension (sq.in.)                452.3904
Stack Static Pressure (in.H2O)         -.01
Stack Moisture Collected (gm)           237.1
Absolute stack pressure(in Hg)          28.97926
Average stack temperature (F)           1129.7
Percent CO2                             10.2
Percent O2                              6.8
Percent N2                              83
Delps Subroutine result                 4.4631
DGM Factor                              .9945
Pitot Constant                          .84
```

```
    R A D I A N   S O U R C E   T E S T
    E P A   M E T H O D S   2 - 5
    F I N A L   R E S U L T S
PLANT                : SITE 06
PLANT SITE           : ATLANTA , GA.
SAMPLING LOCATION    : INCINERATOR OUTLET
TEST #               : 06-HCL-05
DATE                 : 03/22/1985
TEST PERIOD          : 1147-1337

    PARAMETER                   RESULT
    ---------                   ------

    Vm(dscf)                     59.18911
    Vm(dscm)                     1.676236
    Vw gas(scf)                  11.17927
    Vw gas (scm)                 .3165968
    % moisture                   15.88678
    Md                           .8411322
    MWd                          29.904
    MW                           28.01284
    Vs(fpm)                      674.9323
    Vs (mpm)                     205.772
    Flow(acfm)                   2120.367
    Flow(acmm)                   60.0488
    Flow(dscfm)                  573.7462
    Flow(dscmm)                  16.24849
    % I                          115.1933
    % EA                         44.99736




                                           Program Revision:1/16/84
```

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D   2 - 5
   ( R A W   D A T A )
 PLANT              : SITE 06
 PLANT SITE         : ATLANTA , GA.
 SAMPLING LOCATION  : INCINERATOR OUTLET
 TEST #             : 06-HCL-06
 DATE               : 03/25/1985
 TEST PERIOD        : 1100-1300

PARAMETER                                VALUE
---------                                -----

Sampling time (min.)                      120
Barometric Pressure (in.Hg)               29.55
Sampling nozzle diameter (in.)            .685
Meter Volume (cu.ft.)                     65.84
Meter Pressure (in.H20)                   .945
Meter Temperature (F)                     70.04
Stack dimension (sq.in.)                  452.3904
Stack Static Pressure (in.H20)           -.01
Stack Moisture Collected (gm)             217.4
Absolute stack pressure(in Hg)            29.54926
Average stack temperature (F)             1176.9
Percent C02                               9.2
Percent 02                                10.3
Percent N2                                80.5
Delps Subroutine result                   4.7665
DGM Factor                                .9945
Pitot Constant                            .84
```

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT                 : SITE 06
PLANT SITE            : ATLANTA , GA.
SAMPLING LOCATION     : INCINERATOR OUTLET
TEST #                : 06-HCL-06
DATE                  : 03/25/1985
TEST PERIOD           : 1100-1300

   PARAMETER                 RESULT
   ---------                 ------

   Vm(dscf)                   64.57074
   Vm(dscm)                   1.828643
   Vw gas(scf)                10.25041
   Vw gas (scm)               .2902916
   % moisture                 13.69988
   Md                         .8630012
   MWd                        29.884
   MW                         28.25591
   Vs(fpm)                    710.7512
   Vs (mpm)                   216.6924
   Flow(acfm)                 2232.896
   Flow(acmm)                 63.23561
   Flow(dscfm)                613.8705
   Flow(dscmm)                17.38481
   % I                        107.6653
   % EA                       94.04676




                                        Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-HCL-07
DATE : 03/26/1985
TEST PERIOD : 1217-1407

PARAMETER	VALUE
Sampling time (min.)	110
Barometric Pressure (in.Hg)	29.51
Sampling nozzle diameter (in.)	.685
Meter Volume (cu.ft.)	53.95
Meter Pressure (in.H2O)	.65
Meter Temperature (F)	81.82
Stack dimension (sq.in.)	452.3904
Stack Static Pressure (in.H2O)	-.01
Stack Moisture Collected (gm)	154.1
Absolute stack pressure(in Hg)	29.50927
Average stack temperature (F)	1304.7
Percent CO2	7.7
Percent O2	8.899999
Percent N2	83.4
Delps Subroutine result	4.2009
DGM Factor	.9945
Pitot Constant	.84

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT             : SITE 06
PLANT SITE        : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST #            : 06-HCL-07
DATE              : 03/26/1985
TEST PERIOD       : 1217-1407

   PARAMETER                  RESULT
   ---------                  ------

   Vm(dscf)                    51.65181
   Vm(dscm)                    1.462779
   Vw gas(scf)                 7.265816
   Vw gas (scm)                .2057679
   % moisture                  12.33216
   Md                          .8766784
   MWd                         29.588
   MW                          28.15895
   Vs(fpm)                     627.9148
   Vs (mpm)                    191.4374
   Flow(acfm)                  1972.657
   Flow(acmm)                  55.86565
   Flow(dscfm)                 510.3308
   Flow(dscmm)                 14.45257
   % I                         113.0157
   % EA                        67.84776



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```

APPENDIX A-4

MODIFIED METHOD 5 AND EPA METHODS 1-4 SAMPLE CALCULATIONS

RADIAN SOURCE TEST
EPA METHODS 2-5
DEFINITION OF TERMS

PARAMETER	DEFINITION
Tt(min.)	TOTAL SAMPLING TIME
Dn(in.)	SAMPLING NOZZLE DIAMETER
Ps(in.H2O)	ABSOLUTE STACK STATIC GAS PRESSURE
Vm(cu.ft.)	ABSOLUTE VOLUME OF GAS SAMPLE MEASURED BY DGM
Vw(gm.)	TOTAL STACK MOISTURE COLLECTED
Pm(in.H2O)	AVERAGE STATIC PRESSURE OF DGM
Tm(F)	AVERAGE TEMPERATURE OF DGM
Pb(in.Hg.)	BAROMETRIC PRESSURE
% CO2	CARBON DIOXIDE CONTENT OF STACK GAS
% O2	OXYGEN CONTENT OF STACK GAS
% N2	NITROGEN CONTENT OF STACK GAS
SQR(DELPS)	AVE. SQ. ROOT OF S-PITOT DIFF. PRESSURE-TEMP. PRODUCTS
As(sq.in.)	CROSS-SECTIONAL AREA OF STACK(DUCT)
Ts(F)	TEMPERATURE OF STACK
Vm(dscf)	STANDARD VOLUME OF GAS SAMPLED ,Vm(std),AS DRY STD. CF
Vm(dscm)	STANDARD VOLUME OF GAS SAMPLED,Vm(std),AS DRY STD. CM
Vw gas(scf)	VOLUME OF WATER VAPOR IN GAS SAMPLE,STD
% moisture	WATER VAPOR COMPOSITION OF STACK GAS
Md	PROPORTION, BY VOLUME,OF DRY GAS IN GAS SAMPLE
MWd	MOLECULAR WEIGHT OF STACK GAS,DRY BASIS LB/LB-MOLE
MW	MOLECULAR WEIGHT OF STACK GAS,WET BASIC LB/LB-MOLE
Vs(fpm)	AVERAGE STACK GAS VELOCITY
Flow(acfm)	AVERAGE STACK GAS FLOW RATE(ACTUAL STACK COND.)
Flow(acmm)	AVERAGE STACK GAS FLOW RATE(ACTUAL STACK COND.)
Flow(dscfm)	AVERAGE STACK GAS VOLUMETRIC FLOW RATE(DRY BASIS)
Flow(dscmm)	AVERAGE STACK GAS VOLUMETRIC FLOW RATE(DRY BASIS)
% I	PERCENT ISOKINETIC
% EA	PERCENT EXCESS AIR IN STACK GAS
DGM	DRY GAS METER
Y	DRY GAS METER CORRECTION FACTOR
Pg	STACK STATIC GAS PRESSURE
Cp	PITOT COEFFICIENT
dH	ORIFICE PLATE DIFF. PRESS. VALUE
dP	PITOT DIFF. PRESS. VALUE
*** EPA STANDARD CONDITIONS	Temperature = 68 deg-F (528 deg-R) Pressure = 29.92 in. Hg.

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RADIAN SOURCE TEST
EPA METHOD 2-5
SAMPLE CALCULATION

PLANT : SITE 06
PLANT SITE : ATLANTA , GA.
SAMPLING LOCATION : INCINERATOR OUTLET
TEST # : 06-MM5-06
DATE : 03/26/1985
TEST PERIOD : 1220-1420 / 1455-1655

1) Volume of dry gas sampled at standard conditions (68 deg-F ,29.92 in. Hg).

$$Vm(std) = \frac{Y \times Vm \times [T(std) + 460] \times [Pb + (Pm/13.6)]}{P(std) \times (Tm + 460)}$$

$$Vm(std) = \frac{1.004 \times 119.283 \times 528 \times [\ 29.51 + (\ .791 / 13.6)]}{29.92 \times (\ 87.16001 + 460)}$$

$$Vm(std) = 114.207 \text{dscf}$$

2) Volume of water vapor at standard conditions:

$$Vw(gas) = 0.04715 \text{ cf/gm} \times W(1) \text{ gm}$$

$$Vw(gas) = 0.04715 \times 316.2 = 14.909 \text{ scf}$$

3) Percent Moisture in stack gas :

$$\%M = \frac{100 \times Vw(gas)}{Vm(std) + Vw(gas)}$$

$$\%M = \frac{100 \times 14.909}{114.207 + 14.909} = 11.55\ \%$$

4) Mole fraction of dry stack gas :

$$Md = \frac{100 - \%M}{100} = \frac{100 - 11.55}{100} = .8845318$$

SAMPLE CALCULATION
PAGE TWO

```
5)Average Molecular Weight of DRY stack gas :

        MWd = (.44 x %CO2) + (.32 x %O2) + (.28 x %N2)

        MWd = (.44 x 7.7 ) + (.32 x 8.899999 ) + (.28 x  83.4 ) =  29.588

6)Average Molecular Weight of wet stack gas :

        MW   = MWd x Md + 18(1 - Md)

        MW   = 29.588  x   .8845318  + 18(1 -  .8845318 )  =  28.24996

7) Stack gas velocity in feet-per-minute (fpm) at stack conditions :


Vs = KpxCp x [SQRT (dP)]$ave↑ x SQRT [Ts $avg↑] x SQRT [1/(PsxMW)] x 60sec/min

    Vs = 85.49 x .84 x 60 x  4.6224 x SQRT[1/( 29.50927  X  28.24996 )]

    Vs =  689.8033  FPM

8) Average stack gas dry volumetric flow rate (DSCFM) :

               Vs x As x Md x T(std) x Ps
    Qsd =  ----------------------------------------
           144 cu.in./cu.ft. x (Ts +460) x P(std)

            689.8033 x 452.3904 x .8845318 x528x 29.50927
    Qsd =  ----------------------------------------
            144 x  1768  x 29.92

    Qsd =  564.5963 dscfm
```

SAMPLE CALCULATION
PAGE THREE

```
9)Isokinetic sampling rate (%) :

        Dimensional Constant C = K4 x 60 x 144 x [1 / (Pi  /4)]
        K4 = .0945 FOR ENGLISH UNITS

                  C x Vm(std) x (Ts + 460)
        I% =     --------------------------------------
                 Vs x Tt x Ps x Md x (Dn)*2

                   1039.574 x 114.2075 x 1768
        I% = ------------------------------------------
               689.8033 x 240 x 29.50927 x .8845318 x( .685 )*2

        I% =  103.5245

10) Excess air (%) :

                 100 x %O2              100 x 8.899999
        EA =     --------------- = ----------------
                 (.264 x %N2) - %O2  (.264 x 83.4 ) - 8.899999

        EA =        67.85

11) Particulate Concentration :

        Cs = ( grams part.) / Vm(std) =  0 / 114.2075

        Cs =       0.0000000 Grams/DSCF

                 T(std) x Md x Ps x Cs
        Ca =     -------------------------------
                 P(std) x Ts

                 528 x .8845318  x 29.50927  x        0.0000000
        Ca =     -------------------------------
                 29.92       x       1768

        Ca =             0.0000000 Grams/ACF

        LBS/HR =  Cs x 0.002205 x Qsd x 60

        LBS/HR =         0.0000000x 0.002205 x    564.6 x 60

        LBS/HR = 0

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```

APPENDIX B

PROCESS MONITORING DATA

TABLE B-1. RAW PROCESS RATE DATA FOR INCINERATOR WRI-A DURING THE TEST PERIODS

Run Number/ Tray Number	Tray Description	Time In	Time Out	Wire Component			Transformer Component			Total Charge			Fraction of Tray Cycle Sampled (%)	MM5/ Dioxin Sampling Periods
				Weight In (lb)	Weight Out (lb)	Weight (lb)	Weight In (lb)	Weight Out (lb)	Weight (lb)	Weight In (lb)	Weight Out (lb)	Weight (lb)		
Run 01 (3/19/85)														
Tray 1	Wire only	ND	1110*	999	909	90	-	-	-	999	909	90	0	1105-1645
Tray 2	Wire only	1113	1240	1299	1166	133	-	-	-	1299	1166	133	0-100	
Tray 3	Wire only	1244	1415	1139	1036	103	-	-	-	1139	1036	103	0-100	
Tray 4	Wire only	1418	1549	1420	1286	134	-	-	-	1420	1286	134	0-100	
Tray 5	Wire only	1550	1700*	1496	1349	147	-	-	-	1496	1349	147	0- 80	
Run 01 Total (Trays 2-5)	Wire only	-	-	5354	4837	517	0	0	0	5354	4837	517	-	
Run 02 (3/20/85)														
Tray 1	Wire only	0840	0947*	1007	942	65	-	-	-	1007	942	65	0	1055-1255
Tray 2	Wire only	0950	1057*	1027	929	98	-	-	-	1027	929	98	0	1400-1600
Tray 3	Wire only	1100	1218	1083	913	170	-	-	-	1083	913	170	0-100	
Tray 4	Wire only	1220	1334	1293	1135	158	-	-	-	1293	1135	158	0- 50	
Tray 5	Wire only	1335	1506	1094	954	140	-	-	-	1094	954	140	25-100	
Tray 6	Wire only	1508	1700*	1197	1014	183	-	-	-	1197	1014	183	0- 45	
Run 02 Total (Trays 3-6)	Wire only	-	-	4667	4016	651	0	0	0	4667	4016	651	-	
Run 03 (3/21/85)														
Tray 1	Wire only	0840	0955	1039	880	159	-	-	-	1039	880	159	0	1000-1230
Tray 2	Wire only	0956	1138	1260	1082	178	-	-	-	1260	1082	178	0-100	1320-1350
Tray 3	1 Large trnsfrmr only	1140	1320	-	-	-	1273	997	276	1273	997	276	0- 50	1430-1545
Tray 4	Wire only *	1322	1428	1244	1116	128	-	-	-	1244	1116	128	0- 45	1610-1655
Tray 5	2 Med trnsfrmrs only	1430	1700*	-	-	-	2206	1767	439	2206	1767	439	0-50, 70-100	
Run 03 Total (Trays 2-5)	Wire & Transformers	-	-	2504	2198	306	3479	2764	715	5983	4962	1021	-	

Tray 4, Run 03 contained = 80% power company wire + = 20% enameled wire

TABLE B-1. RAW PROCESS RATE DATA FOR INCINERATOR WRI-A DURING THE TEST PERIODS

Run Number/ Tray Number	Tray Description	Time In	Time Out	Wire Component			Transformer Component			Total Charge			Fraction of Tray Cycle Sampled (%)	MM5/ Dioxin Sampling Periods
				Weight In (lb)	Weight Out (lb)	Weight (lb)	Weight In (lb)	Weight Out (lb)	Weight (lb)	Weight In (lb)	Weight Out (lb)	Weight (lb)		
Run 04 (3/22/85)														
Tray 1	Wire only	0915	1017	448	399*	49*	-	-	-	448	399	49	0	1152-1352
Tray 2	Wire + 1 Med Trnsfrmr	1018	1154	399	320	79	1338	1281	57	1737	1601	136	0	1500-1700
Tray 3	Wire + 1 Medium + 1 Small Transformer	1156	1400	636	498	138	1467	1385	82	2103	1883	220	0- 95	
Tray 4	Wire only	1402	1610	1287	1136	151	-	-	-	1287	1136	151	45-100	
Tray 5	1 Large transformer	1613	1700*	-	-	-	1141	891	250	1141	891	250	0-100	
Run 04 Total (Trays 3-5)	Wire & Transformers	-	-	1923	1634	289	2608	2276	332	4531	3910	621	-	
Run 05 (3/25/85)														
Tray 1	Wire only	0840	0957*	644	558	86	-	-	-	644	558	86	0	1105-1305
Tray 2	Wire only	1000	1117*	877	768	109	-	-	-	877	768	109	85-100	1430-1630
Tray 3	1 Large Trnsfrmr only	1120	1534	-	-	-	1102	696	406	1102	696	406	0-40, 75-100	
Tray 4	1 Large Trnsfrmr only	1537	1700*	-	-	-	1012	639*	373	1012	639	373	0- 65	
Run 05 Total (Trays 2-4)	Wire & Transformers	-	-	877	768	109	2114	1335	779	2991	2103	888	-	
Run 06 (3/26/85)														
Tray 1	1 Large Trnsfrmr only	0830	1215	-	-	-	1153	748	405	1153	748	405	0	1220-1420
Tray 2	Wire only	1216	1412*	1212	1043	169	-	-	-	1212	1043	169	0-100	1455-1655
Tray 3	Wire only	1415	1533	1013	820	193	-	-	-	1013	820	193	0-5, 50-100	
Tray 4	Wire only	1535	1700*	1058	932	126	-	-	-	1058	932	126	0- 95	
Run 06 Total (Trays 2-4)	Wire only	-	-	3283	2795	488	0	0	0	3283	2795	488	-	

TABLE B-2. NATURAL GAS CONSUMPTION DATA FOR INCINERATOR WRI-A DURING TEST PERIODS

Date	Time	Meter Reading (Cu Ft)	Differential Meter Reading (Cu Ft)	Time (hr)	Natural Gas Usage Rate (cfm)	Corresponding Run No.
3/19/85	0824	202590	-	-	-	-
3/20/85	1116	203890	1300	11.7	18.5	Run 01
3/21/85	0734	204540	650	5.73	18.9	Run 02
3/22/85	0825	205670	1130	9.5	19.8	Run 03
3/25/85	0800	206890	1220	8.5	23.9	Run 04
3/26/85	0835	208020	1130	9.5	19.8	Run 05
3/27/85	0825	208970	950	9.0	17.6	Run 06
Avg.	-	208970	6380	54.0	19.7	Avg.

Calculations based on afterburner operation from 0800 to 1700 daily.

Spot checks: 3/20/85 20 cu ft in 64 sec. = 18.8 cfm
3/25/85 20 cu ft in 79 sec. = 15.2 cfm
3/26/85 20 cu ft in 64 sec. = 18.8 cfm
Avg. 17.6 cfm

APPENDIX C

SAMPLE SHIPMENT LETTER

RADIAN
CORPORATION

March 27, 19[illegible]

[illegible] EPA [illegible] Analysis Center
[illegible]
[illegible] MD [illegible]

Attention: [illegible] [illegible]

[illegible] Analysis Instructions

[illegible]

The [illegible] of this letter is to clarify instructions and pri[illegible] [illegible] individual samples from specific Tier 4 combustion sites. This [illegible] letter is No. 6 and pertains to EPA Site No. [illegible] at [illegible]lanta, GA.

The [illegible] No. is 7619, and SCC numbers assigned to this [illegible] numbers DD001[illegible] through DD001599.

SCC numbers DD001601 through DD001606 and DD001638 through DD001[illegible] have been assigned to Troika for internal QA/QC purposes. SCC numbers DD001607 through DD001637 have been assigned to field samples. All field samples with SCC numbers are included in this shipment except samples DD001617, DD001619, DD001622, DD001626, DD001627, DD0016[illegible], and DD001[illegible] which are being archived at Radian. SCC numbers DD001[illegible] through DD001[illegible] are unused.

The sample shipment for EPA SITE No. 06 consists of 4 boxes containing 61 sample components in 61 containers. (Note: The Modified Method 5 samples consist of 6 components as listed below and the [illegible] train consists of 7 components as listed below)

Instructions for extraction and analysis follow.

[illegible] following samples require IMMEDIATE EXTRACTION and analysis [illegible] samples).

Sample Set [illegible] 06-MM5-01
([illegible] train components)

SCC #	Component	Fraction
DD001607	1	Filter
DD001607	6	XAD Module
DD001607	2	Probe Rinse
DD001607	3	Back Half / Coil Rinse
DD001607	4	Condensate
DD001607	5	Impinger Solution

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Radian Run # 06-MMS-02
(Total of 6 train components)

SCC #	Components	Fraction
DQ001616	1	Filter
DQ001616	6	XAD Module
DQ001616	2	Probe Rinse
DQ001616	3	Back Half / Coil Rinse
DQ001616	4	Condensate
DQ001616	5	Impinger Solution

Radian Run # 06-MMS-03
(Total of 6 train components)

SCC #	Components	Fraction
DQ001619	1	Filter
DQ001619	6	XAD Module
DQ001619	2	Probe Rinse
DQ001619	3	Back Half / Coil Rinse
DQ001619	4	Condensate
DQ001619	5	Impinger Solution

Radian Run # 06-MMS-04
(Total of 6 train components)

SCC #	Components	Fraction
DQ001623	1	Filter
DQ001623	6	XAD Module
DQ001623	2	Probe Rinse
DQ001623	3	Back Half / Coil Rinse
DQ001623	4	Condensate
DQ001623	5	Impinger Solution

Radian Run # 06-MMS-05
(Total of 6 train components)

SCC #	Components	Fraction
DQ001628	1	Filter
DQ001628	6	XAD Module
DQ001628	2	Probe Rinse
DQ001628	3	Back Half / Coil Rinse
DQ001628	4	Condensate
DQ001628	5	Impinger Solution

Radian Run # 06-MM5-06
(Total of 6 train components)

SCC #	Components	Fraction
DQ001632	1	Filter
DQ001632	6	XAD Module
DQ001632	2	Probe Rinse
DQ001632	3	Back Half / Coil Rinse
DQ001632	4	Condensate
DQ001632	5	Impinger Solution

Radian Run # 06-MM5-Blank
(Total of 6 train components)

SCC #	Components	Fraction
DQ001617	1	Filter
DQ001617	6	XAD Module
DQ001617	2	Probe Rinse
DQ001617	3	Back Half / Coil Rinse
DQ001617	4	Condensate
DQ001617	5	Impinger Solution

The Radian proof train 06-MM5-Proof (cleaned unused field sampling glassware train components) consists of the following fractions:

SCC #	Component	Fraction
DQ001608	2-5	Methylene Chloride Rinse
DQ001608	1	Hexane Extracted Filters (2)
DQ001608	6	Sorbent Module

Field Solvent Blanks:

SCC #	#	Sample Type
DQ001610	06-ACETONE-FBL-A	Acetone
DQ001636	06-ACETONE-FBL-C	Acetone
DQ001611	06-H2O-FBL-A	HPLC H2O
DQ001609	06-MeCL-FBL-A	Methylene Chloride

Settling Chamber Ash - Process Sample:

SCC #	#	Sample Type
DQ001637	06-SCA-01	ASH
DQ001614	06-SCA-02	ASH
DQ001621	06-SCA-03	ASH
DQ001625	06-SCA-04	ASH
DQ001631	06-SCA-05	ASH
DQ001635	06-SCA-06	ASH

Primary Chamber Ash - Process Sample:

SCC #	#	Sample Type
DQ001613	06-PCA-01	ASH
DQ001615	06-PCA-02	ASH
DQ001620	06-PCA-03	ASH
DQ001624	06-PCA-04	ASH
DQ001630	06-PCA-05	ASH
DQ001634	06-PCA-06	ASH

2. The following Priority #2 samples for this site will be held at at Radian for analysis pending the results of Priority #1 analyses:

SCC #	#	Sample Type
DQ001612	06-WIF-01-A	Wire Insulation Feed
DQ001618	06-WIF-02-A	Wire Insulation Feed
DQ001633	06-WIF-06-A	Wire Insulation Feed
DQ001622	06-TF-03-A	Transformer Feed
DQ001626	06-TF-04-A	Transformer Feed
DQ001629	06-TF-05-A	Transformer Feed

3. The soil sample is the only Priority #3 sample. It will be held at Radian for analysis by Troika pending the results of Priority #1 and Priority #2 samples analyses.

SCC #	#	Sample Type
DQ001627	06-S-01	Soils

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If there are any questions concerning this sample shipment, please contact either Jim McReynolds or Larry Keller at Radian Corporation (919) 541-9100.

Sincerely,
Larry Keller
TEST TEAM LEADER

cc: E. Hanks - EPA/AMTB
A. Miles - Radian
Radian Field File

APPENDIX D

RUN-SPECIFIC DIOXIN/FURAN EMISSIONS DATA

APPENDIX D-1

WIRE FEED DIOXIN/FURAN EMISSIONS DATA
(As-measured concentrations)

TABLE D-1. WIRE FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 1, SITE WRI-A (As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	NR	NR	NR
Other TCDD	5.16E-01(N/A)	3.85E-02(N/A)	4.43E-01
Penta-CDD	NR	NR	NR
Hexa-CDD	3.10E+00(N/A)	1.90E-01(N/A)	2.66E+00
Hepta-CDD	3.18E+01(N/A)	1.80E+00(N/A)	2.73E+01
Octa-CDD	1.54E+01(N/A)	8.07E-01(N/A)	1.32E+01
Total PCDD	5.09E+01	2.84E+00	4.36E+01
FURANS			
2378 TCDF	NR	NR	NR
Other TCDF	3.89E+00(N/A)	3.06E-01(N/A)	3.34E+00
Penta-CDF	5.28E+00(N/A)	3.73E-01(N/A)	4.53E+00
Hexa-CDF	1.23E+01(N/A)	7.87E-01(N/A)	1.05E+01
Hepta-CDF	4.74E+01(N/A)	2.79E+00(N/A)	4.07E+01
Octa-CDF	2.70E+01(N/A)	1.46E+00(N/A)	2.32E+01
Total PCDF	9.58E+01	5.71E+00	8.22E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.
NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

TABLE D-2. WIRE FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE WRI-A (As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	NR	NR	NR
Other TCDD	NR	NR	NR
Penta-CDD	NR	NR	NR
Hexa-CDD	NR	NR	NR
Hepta-CDD	2.15E+01(N/A)	1.22E+00(N/A)	1.94E+01
Octa-CDD	1.24E+01(N/A)	6.46E-01(N/A)	1.11E+01
Total PCDD	3.39E+01	1.86E+00	3.05E+01
FURANS			
2378 TCDF	NR	NR	NR
Other TCDF	9.63E+00(N/A)	7.57E-01(N/A)	8.67E+00
Penta-CDF	NR	NR	NR
Hexa-CDF	3.18E+00(N/A)	2.04E-01(N/A)	2.86E+00
Hepta-CDF	6.12E+01(N/A)	3.60E+00(N/A)	5.51E+01
Octa-CDF	2.92E+01(N/A)	1.58E+00(N/A)	2.63E+01
Total PCDF	1.03E+02	6.14E+00	9.29E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.
NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

TABLE D-3. WIRE FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 6, SITE WRI-A (As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	9.29E-02(N/A)	6.94E-03(N/A)	8.92E-02
Other TCDD	1.24E+00(N/A)	9.25E-02(N/A)	1.19E+00
Penta-CDD	2.04E+00(N/A)	1.38E-01(N/A)	1.96E+00
Hexa-CDD	8.82E+00(N/A)	5.43E-01(N/A)	8.47E+00
Hepta-CDD	1.39E+02(N/A)	7.87E+00(N/A)	1.33E+02
Octa-CDD	1.26E+02(N/A)	6.59E+00(N/A)	1.21E+02
Total PCDD	2.77E+02	1.52E+01	2.66E+02
FURANS			
2378 TCDF	3.72E-01(N/A)	2.92E-02(N/A)	3.57E-01
Other TCDF	1.63E+01(N/A)	1.28E+00(N/A)	1.56E+01
Penta-CDF	2.66E+01(N/A)	1.88E+00(N/A)	2.55E+01
Hexa-CDF	6.06E+01(N/A)	3.89E+00(N/A)	5.82E+01
Hepta-CDF	2.54E+02(N/A)	1.49E+01(N/A)	2.44E+02
Octa-CDF	9.97E+01(N/A)	5.40E+00(N/A)	9.57E+01
Total PCDF	4.57E+02	2.74E+01	4.39E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

APPENDIX D-2

WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA
(As-measured concentrations)

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TABLE D-4. WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE WRI-A
(As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	5.12E-02(N/A)	3.82E-03(N/A)	4.45E-02
Other TCDD	2.30E-01(N/A)	1.72E-02(N/A)	2.00E-01
Penta-CDD	4.27E+00(N/A)	2.89E-01(N/A)	3.72E+00
Hexa-CDD	4.95E+01(N/A)	3.05E+00(N/A)	4.31E+01
Hepta-CDD	3.41E+02(N/A)	1.93E+01(N/A)	2.97E+02
Octa-CDD	1.21E+03(N/A)	6.35E+01(N/A)	1.06E+03
Total PCDD	1.61E+03	8.62E+01	1.40E+03
FURANS			
2378 TCDF	4.09E-01(N/A)	3.22E-02(N/A)	3.56E-01
Other TCDF	2.59E+01(N/A)	2.04E+00(N/A)	2.26E+01
Penta-CDF	5.46E+01(N/A)	3.86E+00(N/A)	4.75E+01
Hexa-CDF	1.77E+02(N/A)	1.13E+01(N/A)	1.54E+02
Hepta-CDF	3.86E+02(N/A)	2.27E+01(N/A)	3.36E+02
Octa-CDF	8.08E+02(N/A)	4.38E+01(N/A)	7.03E+02
Total PCDF	1.45E+03	8.38E+01	1.26E+03

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

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TABLE D-5. WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 4, SITE WRI-A (As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	NR	NR	NR
Other TCDD	1.32E+00(N/A)	9.88E-02(N/A)	1.19E+00
Penta-CDD	NR	NR	NR
Hexa-CDD	NR	NR	NR
Hepta-CDD	6.19E+01(N/A)	3.50E+00(N/A)	5.57E+01
Octa-CDD	6.27E+01(N/A)	3.28E+00(N/A)	5.64E+01
Total PCDD	1.26E+02	6.88E+00	1.13E+02
FURANS			
2378 TCDF	NR	NR	NR
Other TCDF	5.42E+01(N/A)	4.26E+00(N/A)	4.87E+01
Penta-CDF	NR	NR	NR
Hexa-CDF	3.78E+01(N/A)	2.43E+00(N/A)	3.40E+01
Hepta-CDF	2.65E+02(N/A)	1.56E+01(N/A)	2.38E+02
Octa-CDF	1.37E+02(N/A)	7.40E+00(N/A)	1.23E+02
Total PCDF	4.93E+02	2.96E+01	4.44E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.
NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

TABLE D-6. WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 5, SITE WRI-A (As-measured concentrations)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	1.15E-01(N/A)	8.61E-03(N/A)	1.22E-01
Other TCDD	1.53E+00(N/A)	1.14E-01(N/A)	1.62E+00
Penta-CDD	3.23E+00(N/A)	2.18E-01(N/A)	3.43E+00
Hexa-CDD	5.50E+00(N/A)	3.39E-01(N/A)	5.85E+00
Hepta-CDD	2.07E+01(N/A)	1.17E+00(N/A)	2.20E+01
Octa-CDD	1.84E+01(N/A)	9.63E-01(N/A)	1.96E+01
Total PCDD	4.95E+01	2.81E+00	5.25E+01
FURANS			
2378 TCDF	8.07E-01(N/A)	6.34E-02(N/A)	8.57E-01
Other TCDF	2.15E+01(N/A)	1.69E+00(N/A)	2.28E+01
Penta-CDF	1.29E+01(N/A)	9.13E-01(N/A)	1.37E+01
Hexa-CDF	2.10E+01(N/A)	1.34E+00(N/A)	2.22E+01
Hepta-CDF	6.17E+01(N/A)	3.63E+00(N/A)	6.55E+01
Octa-CDF	4.61E+01(N/A)	2.50E+00(N/A)	4.89E+01
Total PCDF	1.64E+02	1.01E+01	1.74E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

APPENDIX D-3

WIRE FEED DIOXIN/FURAN EMISSIONS DATA

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TABLE D-7. WIRE FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 1, SITE WRI-A
(Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	NR	NR	NR
Other TCDD	5.59E-01(N/A)	4.18E-02(N/A)	4.43E-01
Penta-CDD	NR	NR	NR
Hexa-CDD	3.36E+00(N/A)	2.06E-01(N/A)	2.66E+00
Hepta-CDD	3.45E+01(N/A)	1.95E+00(N/A)	2.73E+01
Octa-CDD	1.67E+01(N/A)	8.75E-01(N/A)	1.32E+01
Total PCDD	5.52E+01	3.08E+00	4.36E+01
FURANS			
2378 TCDF	NR	NR	NR
Other TCDF	4.22E+00(N/A)	3.32E-01(N/A)	3.34E+00
Penta-CDF	5.72E+00(N/A)	4.05E-01(N/A)	4.53E+00
Hexa-CDF	1.33E+01(N/A)	8.53E-01(N/A)	1.05E+01
Hepta-CDF	5.14E+01(N/A)	3.02E+00(N/A)	4.07E+01
Octa-CDF	2.93E+01(N/A)	1.59E+00(N/A)	2.32E+01
Total PCDF	1.04E+02	6.20E+00	8.22E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.
NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

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TABLE D-8. WIRE FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE WRI-A
(Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	NR	NR	NR
Other TCDD	NR	NR	NR
Penta-CDD	NR	NR	NR
Hexa-CDD	NR	NR	NR
Hepta-CDD	2.24E+01(N/A)	1.27E+00(N/A)	1.94E+01
Octa-CDD	1.29E+01(N/A)	6.72E-01(N/A)	1.11E+01
Total PCDD	3.53E+01	1.94E+00	3.05E+01
FURANS			
2378 TCDF	NR	NR	NR
Other TCDF	1.00E+01(N/A)	7.88E-01(N/A)	8.67E+00
Penta-CDF	NR	NR	NR
Hexa-CDF	3.31E+00(N/A)	2.12E-01(N/A)	2.86E+00
Hepta-CDF	6.37E+01(N/A)	3.74E+00(N/A)	5.51E+01
Octa-CDF	3.04E+01(N/A)	1.65E+00(N/A)	2.63E+01
Total PCDF	1.07E+02	6.39E+00	9.29E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.
NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

TABLE D-9. WIRE FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 6, SITE WRI-A (Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	1.38E-01(N/A)	1.03E-02(N/A)	8.92E-02
Other TCDD	1.84E+00(N/A)	1.38E-01(N/A)	1.19E+00
Penta-CDD	3.04E+00(N/A)	2.05E-01(N/A)	1.96E+00
Hexa-CDD	1.31E+01(N/A)	8.08E-01(N/A)	8.47E+00
Hepta-CDD	2.07E+02(N/A)	1.17E+01(N/A)	1.33E+02
Octa-CDD	1.87E+02(N/A)	9.81E+00(N/A)	1.21E+02
Total PCDD	4.12E+02	2.27E+01	2.66E+02
FURANS			
2378 TCDF	5.53E-01(N/A)	4.34E-02(N/A)	3.57E-01
Other TCDF	2.42E+01(N/A)	1.90E+00(N/A)	1.56E+01
Penta-CDF	3.96E+01(N/A)	2.80E+00(N/A)	2.55E+01
Hexa-CDF	9.02E+01(N/A)	5.78E+00(N/A)	5.82E+01
Hepta-CDF	3.78E+02(N/A)	2.22E+01(N/A)	2.44E+02
Octa-CDF	1.48E+02(N/A)	8.03E+00(N/A)	9.57E+01
Total PCDF	6.80E+02	4.08E+01	4.39E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

APPENDIX D-4

WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA

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TABLE D-10. WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE WRI-A (Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	5.83E-02(N/A)	4.35E-03(N/A)	4.45E-02
Other TCDD	2.62E-01(N/A)	1.96E-02(N/A)	2.00E-01
Penta-CDD	4.87E+00(N/A)	3.29E-01(N/A)	3.72E+00
Hexa-CDD	5.64E+01(N/A)	3.47E+00(N/A)	4.31E+01
Hepta-CDD	3.89E+02(N/A)	2.20E+01(N/A)	2.97E+02
Octa-CDD	1.38E+03(N/A)	7.23E+01(N/A)	1.06E+03
Total PCDD	1.83E+03	9.82E+01	1.40E+03
FURANS			
2378 TCDF	4.66E-01(N/A)	3.66E-02(N/A)	3.56E-01
Other TCDF	2.95E+01(N/A)	2.32E+00(N/A)	2.26E+01
Penta-CDF	6.22E+01(N/A)	4.40E+00(N/A)	4.75E+01
Hexa-CDF	2.01E+02(N/A)	1.29E+01(N/A)	1.54E+02
Hepta-CDF	4.40E+02(N/A)	2.59E+01(N/A)	3.36E+02
Octa-CDF	9.21E+02(N/A)	4.99E+01(N/A)	7.03E+02
Total PCDF	1.65E+03	9.55E+01	1.26E+03

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

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TABLE D-11. WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 4, SITE WRI-A (Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	NR	NR	NR
Other TCDD	1.68E+00(N/A)	1.25E-01(N/A)	1.19E+00
Penta-CDD	NR	NR	NR
Hexa-CDD	NR	NR	NR
Hepta-CDD	7.85E+01(N/A)	4.44E+00(N/A)	5.57E+01
Octa-CDD	7.95E+01(N/A)	4.16E+00(N/A)	5.64E+01
Total PCDD	1.60E+02	8.72E+00	1.13E+02
FURANS			
2378 TCDF	NR	NR	NR
Other TCDF	6.86E+01(N/A)	5.40E+00(N/A)	4.87E+01
Penta-CDF	NR	NR	NR
Hexa-CDF	4.79E+01(N/A)	3.07E+00(N/A)	3.40E+01
Hepta-CDF	3.35E+02(N/A)	1.97E+01(N/A)	2.38E+02
Octa-CDF	1.73E+02(N/A)	9.38E+00(N/A)	1.23E+02
Total PCDF	6.25E+02	3.76E+01	4.44E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.
NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

TABLE D-12. WIRE AND TRANSFORMER FEED DIOXIN/FURAN EMISSIONS DATA FOR RUN 5, SITE WRI-A (Concentrations corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	1.94E-01(N/A)	1.45E-02(N/A)	1.22E-01
Other TCDD	2.57E+00(N/A)	1.92E-01(N/A)	1.62E+00
Penta-CDD	5.43E+00(N/A)	3.67E-01(N/A)	3.43E+00
Hexa-CDD	9.26E+00(N/A)	5.70E-01(N/A)	5.85E+00
Hepta-CDD	3.48E+01(N/A)	1.97E+00(N/A)	2.20E+01
Octa-CDD	3.10E+01(N/A)	1.62E+00(N/A)	1.96E+01
Total PCDD	8.32E+01	4.73E+00	5.25E+01
FURANS			
2378 TCDF	1.36E+00(N/A)	1.07E-01(N/A)	8.57E-01
Other TCDF	3.61E+01(N/A)	2.84E+00(N/A)	2.28E+01
Penta-CDF	2.17E+01(N/A)	1.54E+00(N/A)	1.37E+01
Hexa-CDF	3.52E+01(N/A)	2.26E+00(N/A)	2.22E+01
Hepta-CDF	1.04E+02(N/A)	6.10E+00(N/A)	6.55E+01
Octa-CDF	7.75E+01(N/A)	4.20E+00(N/A)	4.89E+01
Total PCDF	2.76E+02	1.70E+01	1.74E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
2080 operating hours per year

APPENDIX E

ANALYTICAL DATA FOR SITE WRI-A

TABLE E-1. ANALYTICAL DATA FOR THE WIRE-ONLY TEST RUNS

Species	Nanograms Per Sample Train		
	Run 01	Run 02	Run 06
Dioxin			
2378-TCDD	NR	NR	0.3
Other TCDD	1.3	NR	4.0
Penta-CDD	NR	NR	6.6
Hexa-CDD	7.8	NR	28.5
Hepta-CDD	80.2	70.4	449.1
Octa-CDD	38.9	40.4	407.1
Furans			
2378-TCDF	NR	NR	1.2
Other TCDF	9.8	31.5	52.6
Penta-CDF	13.3	NR	85.9
Hexa-CDF	30.9	10.4	195.8
Hepta-CDF	119.4	200.1	819.8
Octa-CDF	68.0	95.5	322.0

NR = data not reported by Troika.

TABLE E-2. ANALYTICAL DATA FOR THE WIRE AND TRANSFORMER TEST RUNS

Species	Nanograms Per Sample Train		
	Run 03	Run 04	Run 05
Dioxin			
2378-TCDD	0.2	NR	0.4
Other TCDD	0.9	4.3	5.3
Penta-CDD	16.7	NR	11.2
Hexa-CDD	193.6	NR	19.1
Hepta-CDD	1334.3	201.2	71.8
Octa-CDD	4747.3	203.8	63.9
Furans			
2378-TCDF	1.6	NR	2.8
Other TCDF	101.4	176.0	74.5
Penta-CDF	213.5	NR	44.8
Hexa-CDF	690.9	122.9	72.7
Hepta-CDF	1511.2	859.7	214.0
Octa-CDF	3160.4	443.8	159.9

NR = data not reported by Troika.

APPENDIX F

RISK MODELING INPUT DATA FOR SITE WRI-A

APPENDIX F-1

WIRE-ONLY FEED

TABLE F-1. RISK MODELING INPUT PARAMETERS FOR RUN 01 SITE WRI-A (WIRE-ONLY FEED)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	NR	NR	1.000	NR
Other TCDD	5.16E-01	4.43E-01	.010	9.21E-03
2378 TCDF	NR	NR	.100	NR
Other TCDF	3.89E+00	3.34E+00	.001	6.94E-03
Penta-CDD	NR	NR	.500	NR
Penta-CDF	5.28E+00	4.53E+00	.100	9.42E-01
Hexa-CDD	3.10E+00	2.66E+00	.040	2.21E-01
Hexa-CDF	1.23E+01	1.05E+01	.010	2.19E-01
Hepta-CDD	3.18E+01	2.73E+01	.001	5.68E-02
Hepta-CDF	4.74E+01	4.07E+01	.001	8.46E-02
Octa-CDD	1.54E+01	1.32E+01	.000	.00E+00
Octa-CDF	2.70E+01	2.32E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				1.54E+00

NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
2080 operating hours per year

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TABLE F-2. RISK MODELING INPUT PARAMETERS FOR RUN 02
SITE WRI-A (WIRE-ONLY FEED)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	NR	NR	1.000	NR
Other TCDD	NR	NR	.010	NR
2378 TCDF	NR	NR	.100	NR
Other TCDF	9.63E+00	8.67E+00	.001	1.80E-02
Penta-CDD	NR	NR	.500	NR
Penta-CDF	NR	NR	.100	NR
Hexa-CDD	NR	NR	.040	NR
Hexa-CDF	3.18E+00	2.86E+00	.010	5.95E-02
Hepta-CDD	2.15E+01	1.94E+01	.001	4.03E-02
Hepta-CDF	6.12E+01	5.51E+01	.001	1.15E-01
Octa-CDD	1.24E+01	1.11E+01	.000	.00E+00
Octa-CDF	2.92E+01	2.63E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				2.32E-01

NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
2080 operating hours per year

TABLE F-3. RISK MODELING INPUT PARAMETERS FOR RUN 06
SITE WRI-A (WIRE-ONLY FEED)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	9.29E-02	8.92E-02	1.000	1.85E-01
Other TCDD	1.24E+00	1.19E+00	.010	2.47E-02
2378 TCDF	3.72E-01	3.57E-01	.100	7.42E-02
Other TCDF	1.63E+01	1.56E+01	.001	3.25E-02
Penta-CDD	2.04E+00	1.96E+00	.500	2.04E+00
Penta-CDF	2.66E+01	2.55E+01	.100	5.31E+00
Hexa-CDD	8.82E+00	8.47E+00	.040	7.05E-01
Hexa-CDF	6.06E+01	5.82E+01	.010	1.21E+00
Hepta-CDD	1.39E+02	1.33E+02	.001	2.78E-01
Hepta-CDF	2.54E+02	2.44E+02	.001	5.07E-01
Octa-CDD	1.26E+02	1.21E+02	.000	.00E+00
Octa-CDF	9.97E+01	9.57E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				1.04E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
2080 operating hours per year

APPENDIX F-2

WIRE AND TRANSFORMER FEED

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TABLE F-4. RISK MODELING INPUT PARAMETERS FOR RUN 03 SITE WRI-A (WIRE AND TRANSFORMER FEED)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	5.12E-02	4.45E-02	1.000	9.26E-02
Other TCDD	2.30E-01	2.00E-01	.010	4.17E-03
2378 TCDF	4.09E-01	3.56E-01	.100	7.41E-02
Other TCDF	2.59E+01	2.26E+01	.001	4.69E-02
Penta-CDD	4.27E+00	3.72E+00	.500	3.86E+00
Penta-CDF	5.46E+01	4.75E+01	.100	9.88E+00
Hexa-CDD	4.95E+01	4.31E+01	.040	3.58E+00
Hexa-CDF	1.77E+02	1.54E+02	.010	3.20E+00
Hepta-CDD	3.41E+02	2.97E+02	.001	6.18E-01
Hepta-CDF	3.86E+02	3.36E+02	.001	6.99E-01
Octa-CDD	1.21E+03	1.06E+03	.000	.00E+00
Octa-CDF	8.08E+02	7.03E+02	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				2.21E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
2080 operating hours per year

TABLE F-5. RISK MODELING INPUT PARAMETERS FOR RUN 04 SITE WRI-A (WIRE AND TRANSFORMER FEED)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	NR	NR	1.000	NR
Other TCDD	1.32E+00	1.19E+00	.010	2.48E-02
2378 TCDF	NR	NR	.100	NR
Other TCDF	5.42E+01	4.87E+01	.001	1.01E-01
Penta-CDD	NR	NR	.500	NR
Penta-CDF	NR	NR	.100	NR
Hexa-CDD	NR	NR	.040	NR
Hexa-CDF	3.78E+01	3.40E+01	.010	7.08E-01
Hepta-CDD	6.19E+01	5.57E+01	.001	1.16E-01
Hepta-CDF	2.65E+02	2.38E+02	.001	4.95E-01
Octa-CDD	6.27E+01	5.64E+01	.000	.00E+00
Octa-CDF	1.37E+02	1.23E+02	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				1.45E+00

NR = not reported by Troika.
ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
2080 operating hours per year

TABLE F-6. RISK MODELING INPUT PARAMETERS FOR RUN 05 SITE WRI-A (WIRE AND TRANSFORMER FEED)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	1.15E-01	1.22E-01	1.000	2.55E-01
Other TCDD	1.53E+00	1.62E+00	.010	3.37E-02
2378 TCDF	8.07E-01	8.57E-01	.100	1.78E-01
Other TCDF	2.15E+01	2.28E+01	.001	4.74E-02
Penta-CDD	3.23E+00	3.43E+00	.500	3.56E+00
Penta-CDF	1.29E+01	1.37E+01	.100	2.85E+00
Hexa-CDD	5.50E+00	5.85E+00	.040	4.86E-01
Hexa-CDF	2.10E+01	2.22E+01	.010	4.63E-01
Hepta-CDD	2.07E+01	2.20E+01	.001	4.57E-02
Hepta-CDF	6.17E+01	6.55E+01	.001	1.36E-01
Octa-CDD	1.84E+01	1.96E+01	.000	.00E+00
Octa-CDF	4.61E+01	4.89E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				8.06E+00

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
2080 operating hours per year